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Operation and Installation Manual

PRDS | PRS | DSH SYSTEMS

Energy Conservation | Environment | Process Efficiency

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DATE: 1 JAN 2013 REVISION: 0

OPERATION AND INSTALLATION MANUAL

PRESSURE REDUCING CUM
DESUPERHEATING STATION (PRDS),

PRESSURE REDUCING STATION (PRS)
&
DESUPERHEATING STATION (DSH)
DEPARTMENT: VALVE STATION

Dear Customer,

Thank you very much for dealing with us! On behalf of everyone at Forbes Marshall, we would like to express our gratitude for choosing us to offer our services to your esteemed organization. We look forward to hear from you, your valuable feedback is the key for advancement, enhancements of our services, performance and durability of the equipment's.

With the same idea of serving you better we have documented few points to be followed for successful commissioning and periodic maintenance of the system. We have taken every care to incorporate all the relevant information in this manual.

Thank you once again for your continued patronage and assure you our best services at all times.

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PRINCIPLE OF OPERATION

PRESSURE REDUCING STATION (PRS)

It is a total mechanical and instrumentation system which is mainly used for Pressure reducing of the fluid. Fluid can be steam, water, nitrogen oxygen or any kind of chemical liquid of gas. The Control valve is the heart if this system, generally known as Final Control Element in the instrumentation loop. Control valve reduces the pressure of the fluid by restricting its path by means of TRIM (consists of Plug, Seat and Spindle). It can be supplied with Flanged ends for lower pressure and in Butt Weld or Socket weld for higher pressures.

There are generally two types of PRS Valves

1. PRS control valve with positioner
2. PRS control valve with roboter

1) PRS Control Valve with Positioner

There is a pressure control loop for the PRS which consists of Pressure transmitter and PID controller. In the outlet from the condensing pot, impulse piping for the pressure transmitter is done at site. Tubing is done from the PT to the PID controller and from controller to the positioner of the PRS control valve. When the system is on, the outlet pressure is sensed at the PT and the feedback is given to the positioner of the control valve via the PID controller and accordingly the valve opens or closes, hence maintaining the outlet pressure

2) PRS Control Valve with Roboter

For this type of valve, there is no need for a pressure control loop. A tapping is taken from the outlet of the PRS station and is directly connected to the roboter of the valve by pipe. The pressure is sensed by the roboter and monitors the opening and closing of the valve, hence controlling the outlet pressure.

Safety relief valve is used at the outlet of the system to ensure that the pressure in the line does not exceed the preset limit in the line. When the pressure exceeds the preset limit the safety relief valve opens at the pressure called the set pressure thereby releasing any excess pressure build up in the line.

When the mainline is working, the inlet and outlet isolation valves are open and control valve is in operating condition. The bypass isolation valve is closed in this condition. When the mainline breaks or is closed for maintenance, the inlet and outlet gate valves are shut and the bypass isolation valve is opened and the pressure at the outlet is controlled by the bypass isolation valve.

PRESSURE REDUCING CUM DESUPER-HEATING STATION (PRDS)

Pressure reducing cum Desuperheating station is used to condition the steam generated from the boiler to the desired outlet pressure and temperature. The pressure control loop is same as above, in addition to this there is a temperature control loop, desuperheating station (waterline), and optionally Fixed Nozzle Desuperheater (FND) / Variable Nozzle Desuperheater (VND)/ minicooler is provided. The temperature control loop consists of Temperature sensor, temperature transmitter and PID controller. Tubing is done for connection of the TT to the water control valve of the desuperheater (waterline) Desuperheater (waterline) connection is made to the PRDS valve; there are two types of water connections in the PRDS valve:

1. Top Entry PRDS
2. Bottom Entry PRDS

The Pressure reducing is done as with the help of the Pressure control loop in the same manner as for the PRS. In the temperature control loop, the temperature sensor senses the temperature which is read in the temperature transmitter and the feedback is given to the water control valve of the waterline. The temperature transmitter sends the signal to the PID controller and this in turn sends the feedback signal to the water control valve which controls the flow of the water from the waterline reaching the PRDS valve, and water is sprayed in to the PRDS valve which mixes with the steam, hence reducing the temperature of the steam.

When the mainline is working, the inlet and outlet isolation valves are open and control valve is in operating condition. The bypass isolation valve is closed in this condition. When the mainline breaks or is closed for maintenance, the inlet and outlet gate valves are shut and the bypass isolation valve is opened and the pressure at the outlet is controlled by the bypass isolation valve.

INSTALLATION AND COMMISSIONING

GUIDELINES FOR PRDS

The inter connecting pipe work connecting the water line with the PRDS valve is generally in customer's scope as the connecting distances are generally not known in advance and that can very easily be done at the site after the steam and water lines are laid down.

In case your PRDS station is flanged, the piping has been dismantled after hydro testing, and dispatched with proper match marking and tagging. The valves have been packed separately and duly marked.

PLEASE GO THROUGH YOUR PACKING LIST AND ENSURE THAT ALL THE ITEMS MENTIONED IN THE PACKING LIST HAVE BEEN RECEIVED.

Now you are ready to install your PRDS station on line

1. The system has to install as per the engineering drawing. Please take care of the straight length of the main line, i.e. minimum 4 meters length of straight line is required. Temperature sensor should be mounted only after 12 meters of length.
2. Once all above is done, please check all the equipment's are in its place as per drawing and as per the direction of the arrows marked on each units, especially on the control valve.
3. Give the instrument pneumatic connection, which should be free from dust, oil and moisture. Once the connection is made ready, please make sure that these connections are tested for leakages by soap solution method.
4. Flushing the lines – the streamline should be flushed with water for about 20-30 minutes with 1-2 kg/cm2 water pressure before installing the control valve in the line. Carry out the flushing for water line as well. Please make sure that the line should be free from muck, welding burrs and other solid particles.
5. Once the above is done, install the valve in the line and calibrate the same by simulator or by the controller in manual mode. Check for each loop with the respective controller.
6. Now charge the steam line with steam, by crack opening the bypass isolation valve, for about 20-30 minutes and then close the valve. During this operation check for any leakage, if any, please attend the same before the start up.
7. Please put the water line loop in auto mode independent of main steam line. The water pressure should be as mentioned in the drawing. Please make sure that the capacity of the boiler feed water pump should cater for both boiler and the system requirement. Now open the inlet isolation valve and operate the main control valve of PRDSH up to 5 – 10% set the outlet pressure to the required set point.
8. Once you achieve the outlet pressure, and then tune the PRDSH system in auto mode, once the PRDSH get tuned to the process parameter then tune the water control valve loop.
9. Observe the system for about 2–3 hours. This completes the commissioning of PRDSH System.

REQUIREMENT AT THE PLACE OF INSTALLATION

The place of installation should be easily accessible and provide ample space for maintenance and removing the actuator. Install a stop valve upstream and downstream of the pressure reducing valve to enable repair and maintenance work, without emptying the system. A bypass line enables a continuous working by hand. The piping before and after the pressure reducing valve must be dimensioned so that the max. flow speed is not exceeded and the pressure reduction should be near to the user.

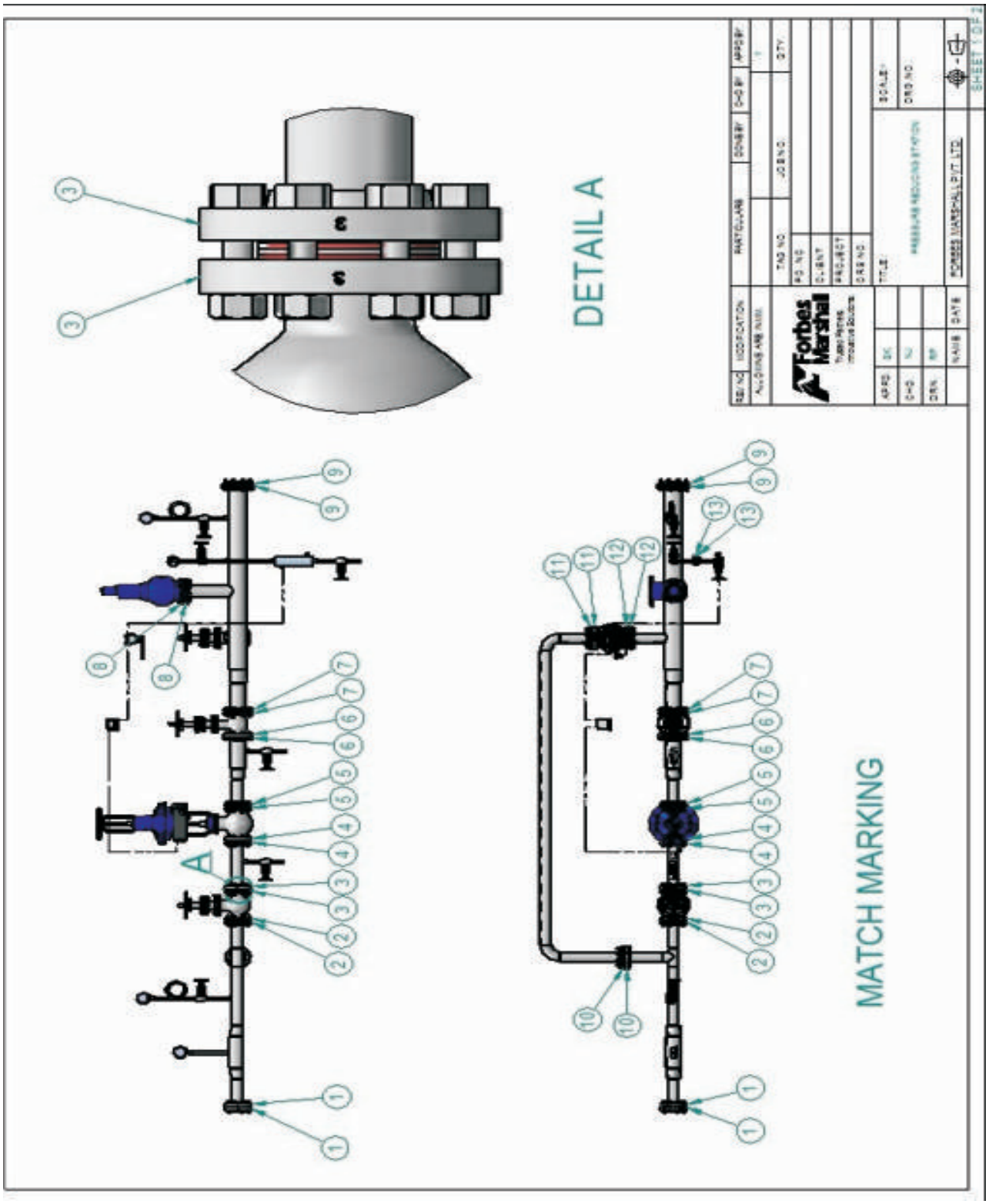
MATCH MARK

A mark made on mating components of an engine, machine, etc., to ensure that the components are assembled in the correct relative positions.

Advantages

- Eases assembling of the station.
- Reduces assembling time.
- More accuracy while assembling a station.
- Reduces search time of the mating components.
- Simple to understand.

It is recommended to assemble as per match mark. Refer fig. (On next page) for match mark in station.


DETAIL A
MATCH MARKING
A

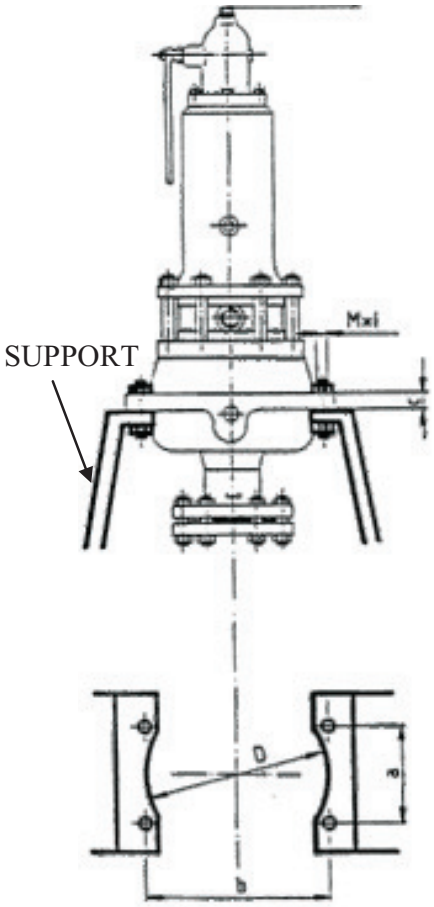
Check List For Commissioning Of the Combined PRDSH Station.

Sr.No.	Work To be Done.	Completed Yes/No.	If not, by when it will get completed
1	Is the PRDSH station Installed in the line?		
2	Is the Pressure sensor assembly with condensing pot installed?		
3	Is the Temp Sensor with thermowell installed at around 10 to 12 meters after the de-superheater nozzle / or 10 -12 mtrs after the control valve (if de-superheater water line given to control valve.)		
4	Is the PID controllers mounted at proper place?		
5	Is the signal cables laid from Pressure Transmitter & Temp sensor up to the PID controllers?		
6	Is the signal cable laid from PID Controllers to both control valves?		
7	Is the dry air pneumatic lines given up to the AFR of the both control valves?		
8	Is the de-superheating water line from pump to water control valve given?		
9	Is the temperature gauges mounted at inlet and outlet of the de-superheator nozzle or control valve (if it is combined valve?)		
10	Is the Pressure gauges mounted at inlet and outlet of the control valve?		

SUPPORT INSTRUCTION OF SAFETY VALVE

Dimensions for Mounting Bracket (Client Scope)

orifice letter SKB			dimensions in mm				
Sempell	API		a	b	c	D	
A	EA	III - IV	106	152	10	160	M12 x 65
B	FA	III	106	152	10	160	M12 x 65
		IV	104	194	10	180	M12 x 65
C		III	106	152	10	160	M12 x 65
		IV	104	194	10	180	M12 x 65
D	GA	I	98	140	10	150	M 8 x 55
		II	106	152	10	160	M12 x 65
		III - IV	104	194	10	180	M12 x 65
E	HA	I	98	140	10	150	M 8 x 65
		II	106	152	10	160	M12 x 65
		III - IV	104	194	10	180	M12 x 65
F		I	126	180	12	190	M12 x 65
		I - IV	138	196	15	200	M16 x 80
G	JA	I - II	138	196	15	210	M16 x 80
		III - IV	138	196	15	210	M16 x 80
H	KA	I - II	160	230	15	250	M16 x 80
		III - IV	160	230	15	250	M16 x 80
J		I - III	184	262	15	290	M16 x 80
		IV	184	262	15	290	M16 x 80
K	LA	I - IV	192	274	15	300	M16 x 80
L	MA, NA	I - IV	200	286	15	310	M16 x 80
M		I - IV	230	328	15	370	M16 x 80
N	PA	I -III	242	344	20	380	M20 x 100
P		I - III	288	410	20	460	M20 x 100
Q	QA	I - III	288	410	20	460	M20 x 100
R	RA	I - III	288	426	20	480	M20 x 100
S	TA	I	350	350	25	430	M20 × 135
T		I	400	400	30	480	M20 × 135
U		I	450	450	30	530	M20 × 140
V		I	550	550	30	680	M20 × 140
W		I	640	640	30	780	M20 × 140
X		I	720	720	60	900	M24 × 180
Y		I	860	860	60	1050	M24 × 180
Z		I	950	950	60	1140	M24 × 180



- IT IS RECOMMENDED TO HAVE SAFETY VALVE SUPPORT AS PER ABOVE FIG.
- INSULATION, STRESS ANALYSES, SUPPORT FOR PIPING, SAFETY VALVE OUTLET PIPING & SAFETY VALVE SUPPORT IS IN CLIENT'S SCOPE OF SUPPLY.
- FORBES MARSHALL WILL NOT BE RESPONSIBLE FOR ANY DAMAGES DUE TO INCORRECT OR NO SUPPORT.

DO & DON'TS

1. Install a strainer before the pressure reducing valve, to avoid the collection of condensate.
2. Strainer must be cleaned from time to time.
3. The system behind the pressure reducing valve (downstream pressure side) the control line and actuator must be protected against excess pressure.
4. Before putting the valve into operation, check material, pressure, temperature and direction of flow.
5. Regional safety instruction must be adhered to.
6. Before putting a new plant into operation or restarting a plant after repairs of modification, always make sure that:

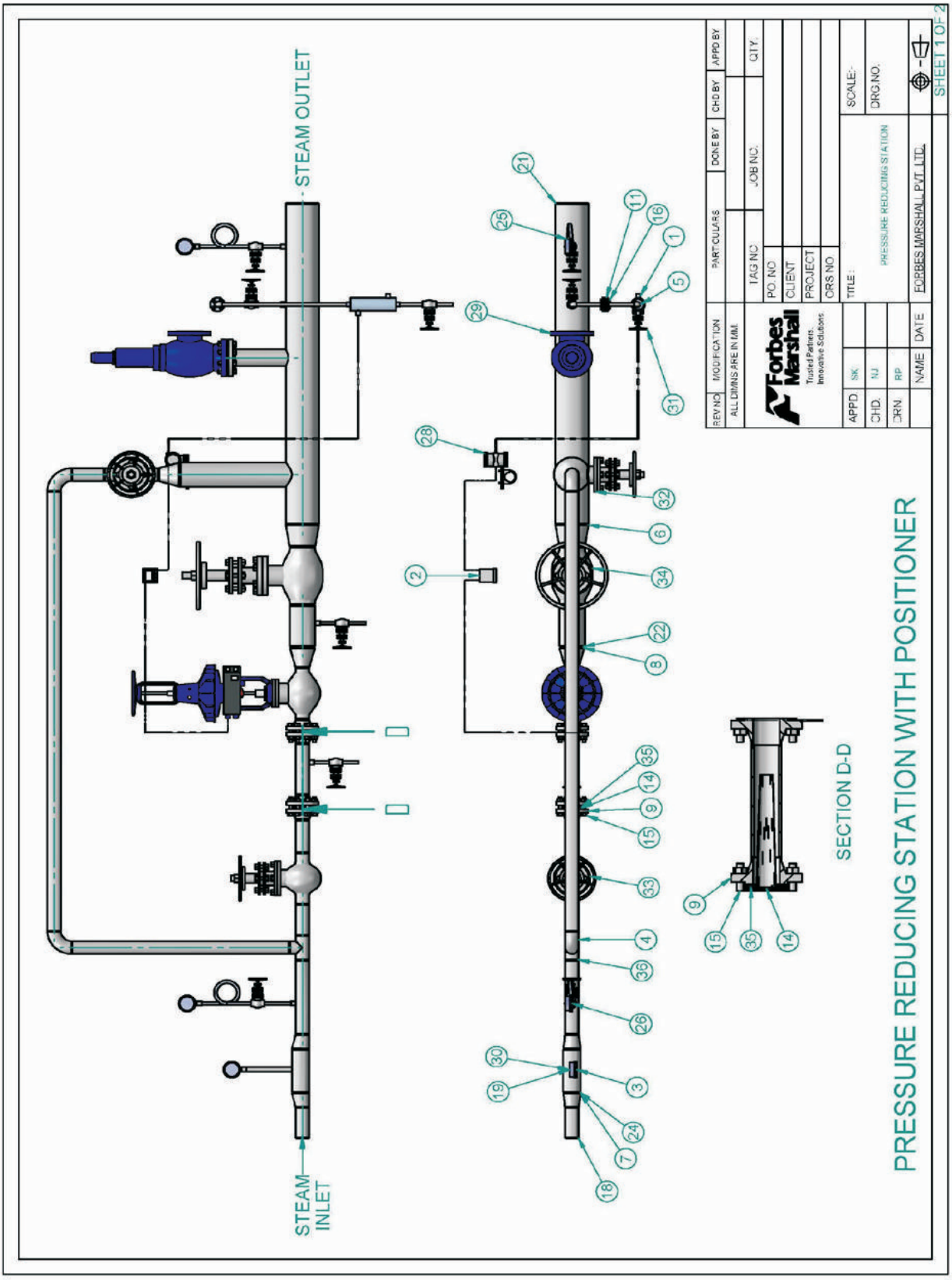
- All works has been completed
- The valve is in the correct position for its function.
- Safety device have been attached

7. Valve mountings such as actuators, hand wheels, hood must not be used to take external forces e.g. they are not designed for use as climbing aids, or as connecting points for lifting gear
8. Suitable material handling and lifting equipment's should be used.
9. Handling and warning must be carried out by expert personnel or all activities must be supervised and checked.
10. Remove flanges cover if present.
11. The interior of valve and piping line must be free from foreign particles.
12. Note installation position with reference to flow, see mark on valve.
13. Lay pipelines so that damaging transverse, bending and torsional forces are avoided.
14. Protect valves from dirt during construction work
15. Connection flanges must mate exactly.
16. Connecting bolts for pipe flanges should be mounted preferably from the counter flange side (hexagon nuts from the valve side)
17. For application outside or in adverse environments like corrosion promoting condition (sea water, chemical vapours etc), special constructions or protection measures are recommended
18. Before installing the pressure reducing valve rinse and clean the system otherwise seat/disc will be damaged and the control hole will be blocked.
19. It is not permitted to mantle/ dismantle actuator with valves operating and service conditions (temperature and pressure)
20. Do not disconnect control line piping in service condition.

TROUBLESHOOTING

Fault	Possible cause	Corrective measures
Little flow	Dirt sieve clogged.	Clean/replace sieve
	Piping system clogged	Check piping system
	Kvs value of valve unsuitable	Fit valve with higher Kvs value
Downstream pressure rises quickly when the user are turned off	Seat/ disc leakage, very dirty	Change valve or if necessary seat/plug
	Control line or flow restrictor blocked	Clean control line or flow restrictor
	Diaphragm defect	Change diaphragm
	Thread plug blocked	Open hole in the vent plug screw
	Pressure balancing hole in the disc blocked	Open pressure balance hole
	Balance bellows defect	Renew balance bellows
	Valve in the control line closed	Open valve in the control line
Flange broken	Damage during transport	Replace
	Flange bolts not evenly tightened	Replace
	Transfer of unsafe forces such as bending or torsional forces	Install free of tension
Media comes out of the vent plug hole	Diaphragm leaking	Change diaphragm
Downstream pressure cannot be adjusted in the full capacity range	Valve laid out to small	New layout of valve
	Valve setting is wrong	Reset valve
Valve doesn't regulate	Control line or flow restrictor blocked	Clean control line or flow restrictor

Fault	Possible cause	Corrective measures
	Diaphragm defect	Change diaphragm
	Control line is connected to the vent plug hole	Fix control line pipe to the control pipe connection
Downstream pressure unstable	Flow restrictor not installed	Install flow restrictor
	The ratio of upstream to downstream pressure is high	Reduction over two stages install pressure reducing valve in row
Media exit out of the bonnet	Gland packing defect	Change gland packing
Valve stem moves in jerk	Valve plug slightly seized owing to solid dirt particle	Clean internal change plug and guide bush
Leakage too high when valve is closed	Sealing surface of seat/plug eroded or worn	Change valve or if necessary seat/plug
	Seeking edge of seating damages or worn Seat/plug	Change valve or if necessary, seat/plug, fit strainer if necessary
	Leaking due to dirt	Clean internals of valve fit strainer if necessary
		Change valve or if necessary seat/plug
Unsafe rise in downstream pressure	Safety valve not present in downstream	Fit safety valve
	Safety valve too small/ wrong size	Reset safety valve and replace if necessary


STEAM OUTLET
STEAM INLET
SECTION D-D
PRESSURE REDUCING STATION WITH POSITIONER
PRESSURE REDUCING STATION
FORBES MARSHALL PVT LTD.
SHEET 1 OF 2
REV NO
MODIFICATION
PARTICULARS
DONE BY
CHD BY
APPD BY
ALL DIMNS ARE IN MM
TAG NO
PO. NO
CLIENT
PROJECT
ORS NO
JOB NO.
QTY.
TITLE :
SCALE:-
DRG NO.
APPD
CHD.
DRN.
NAME
DATE
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NJ
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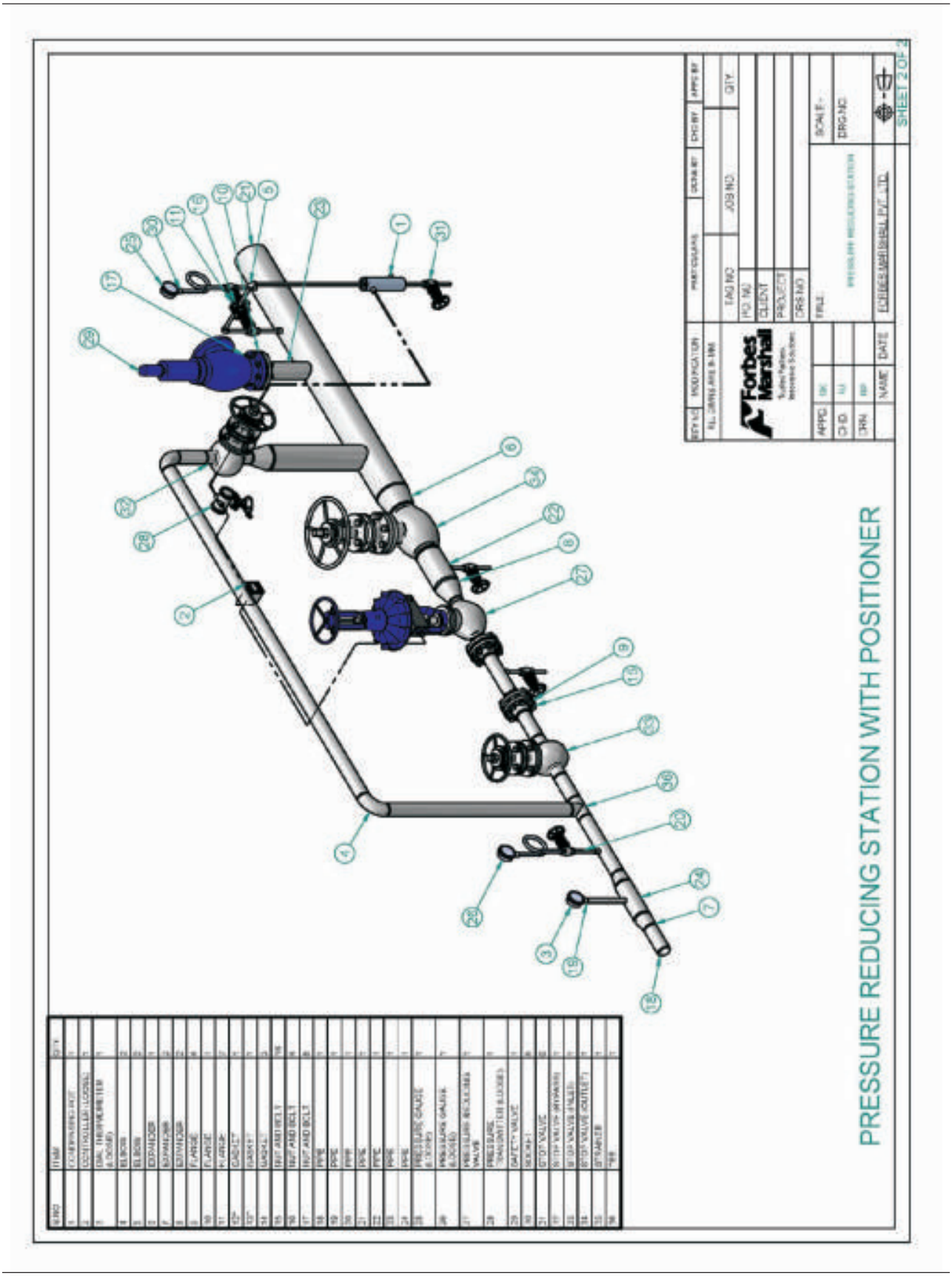
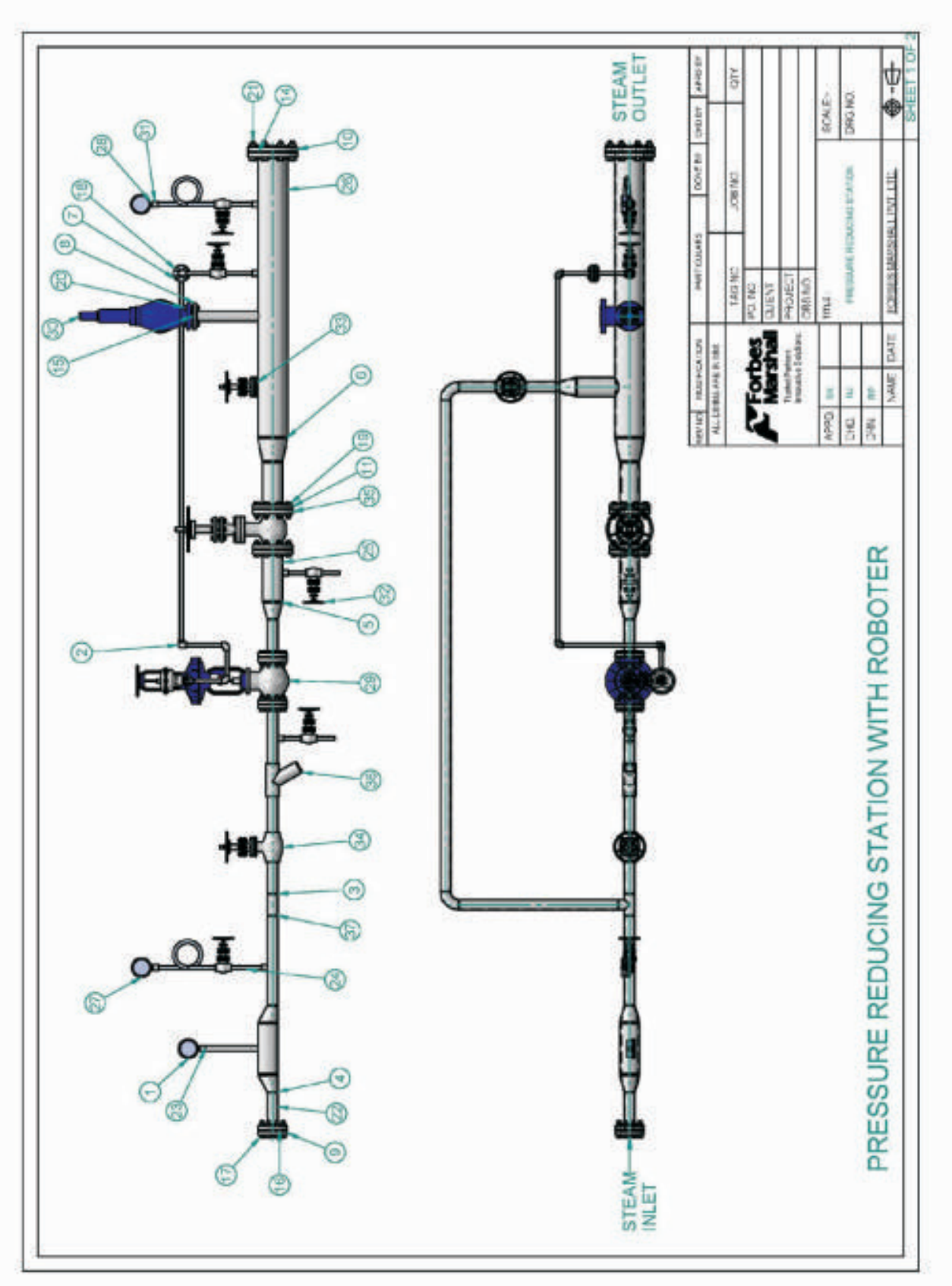
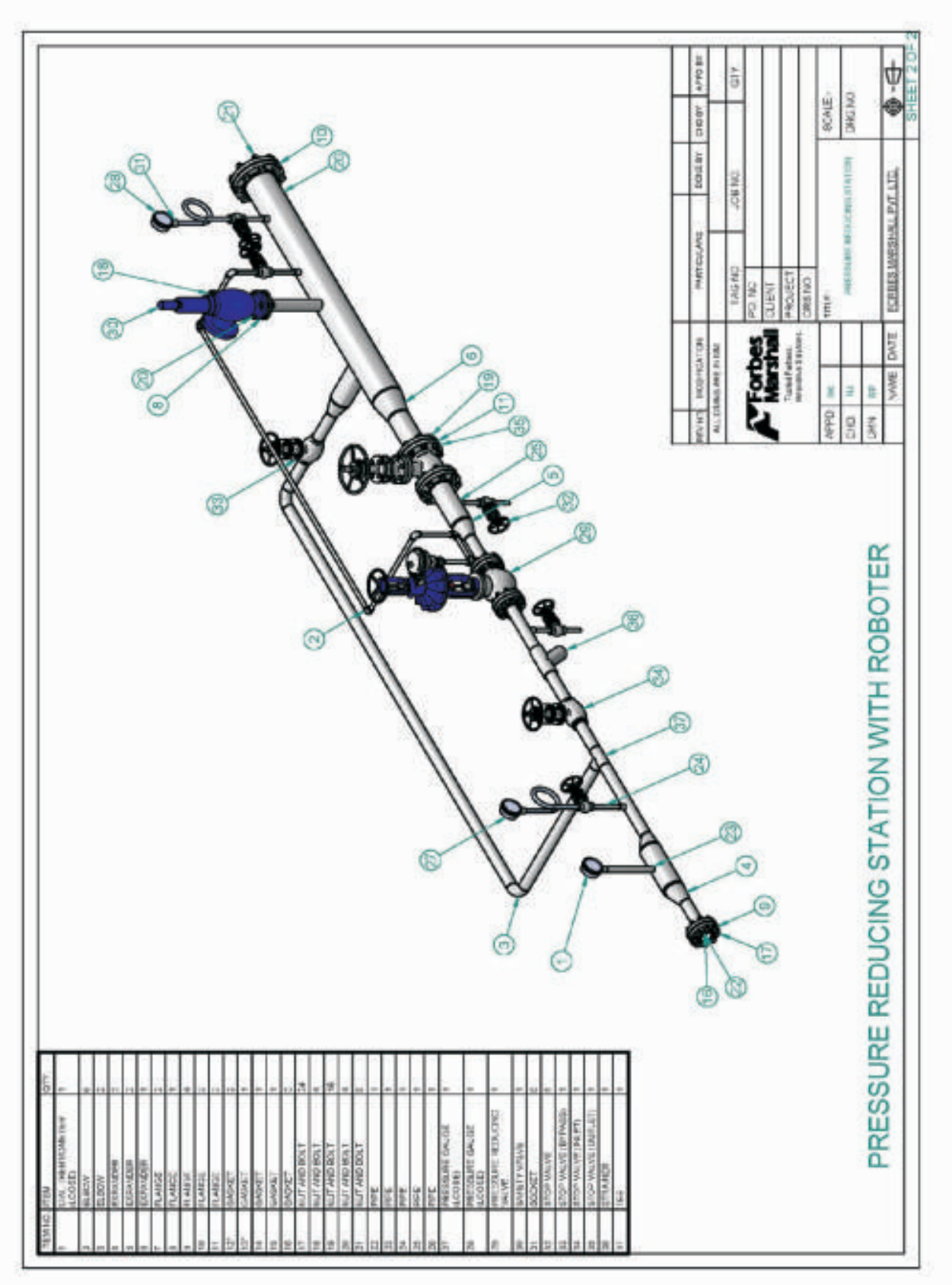
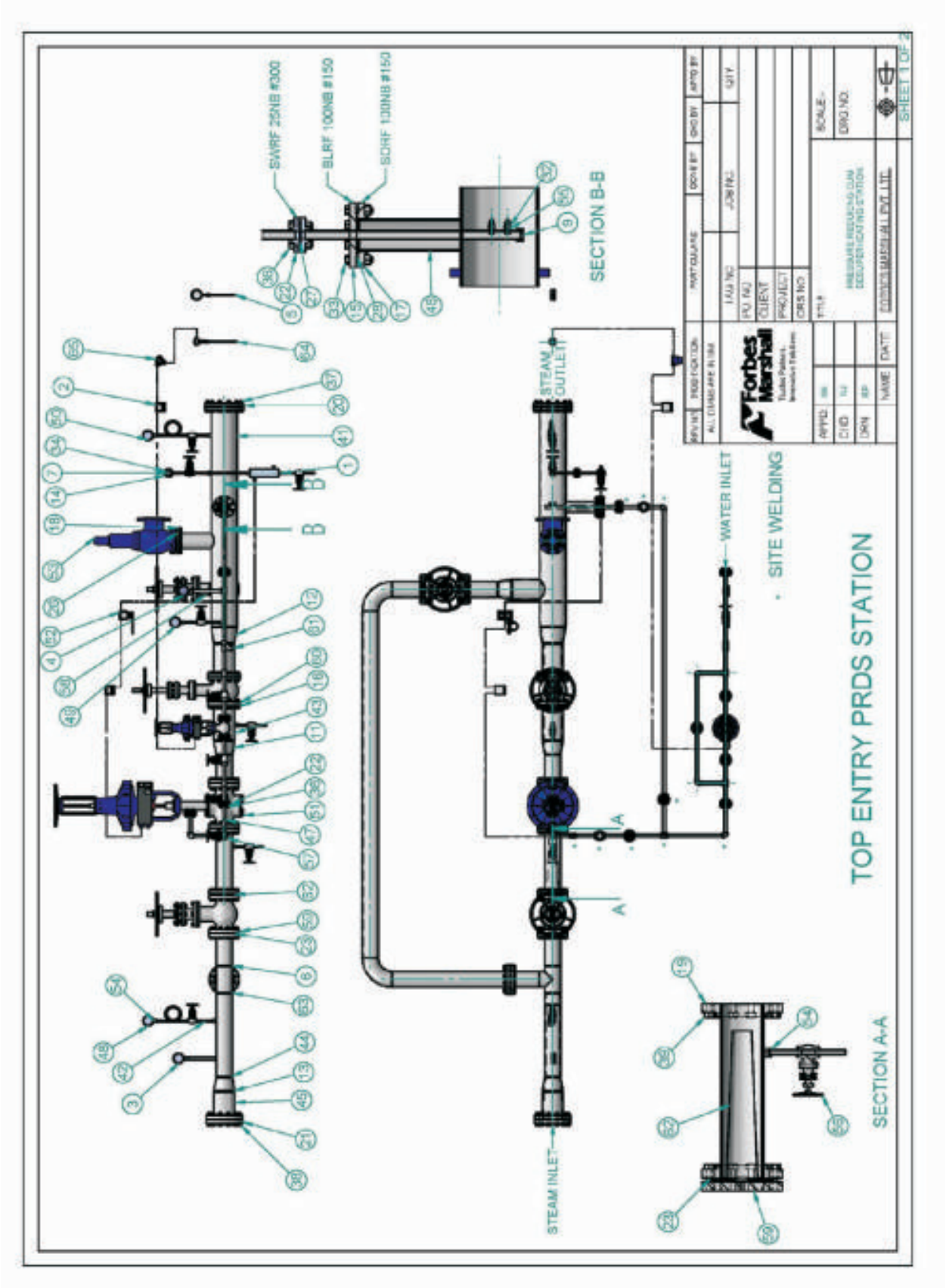
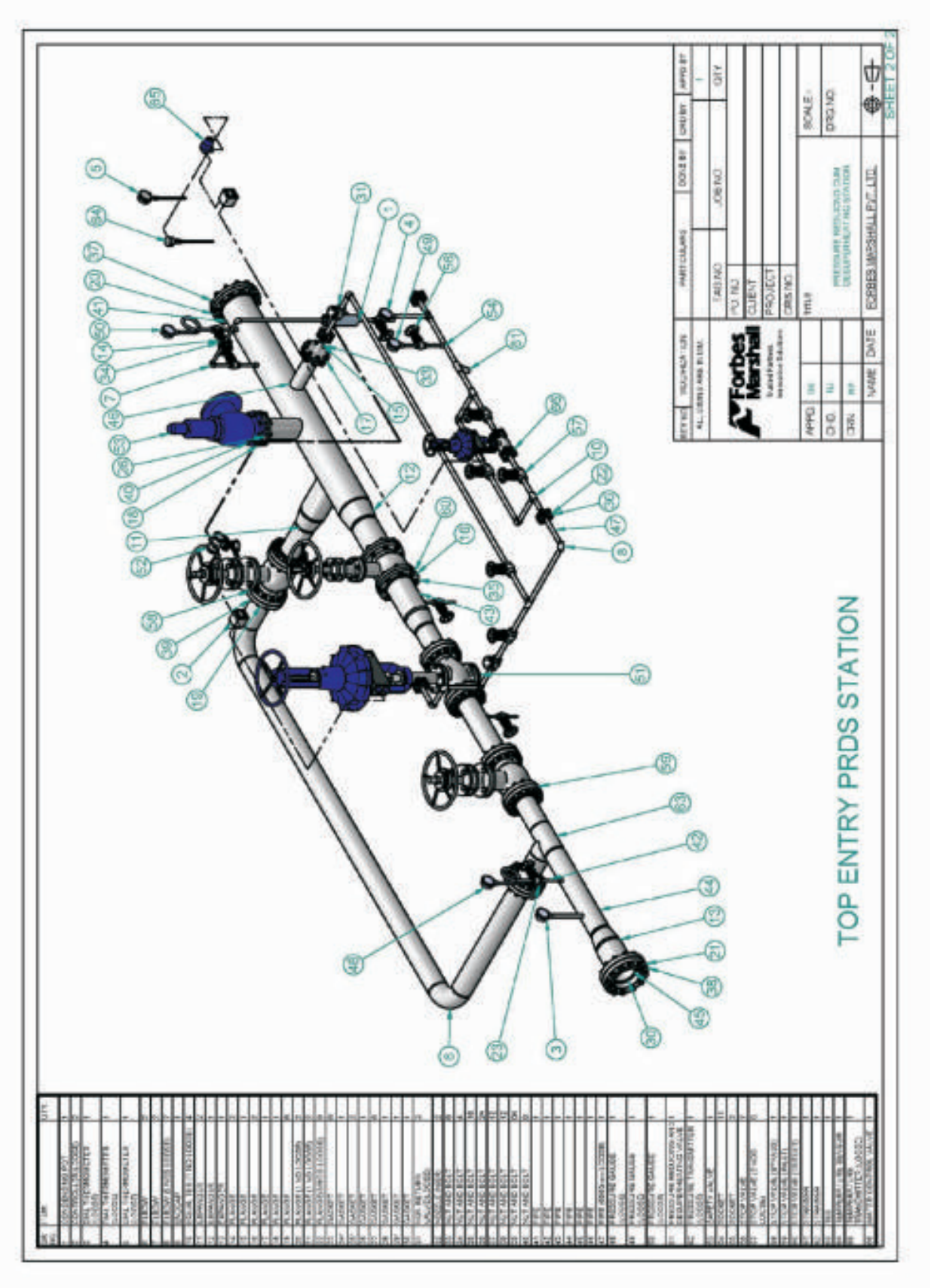
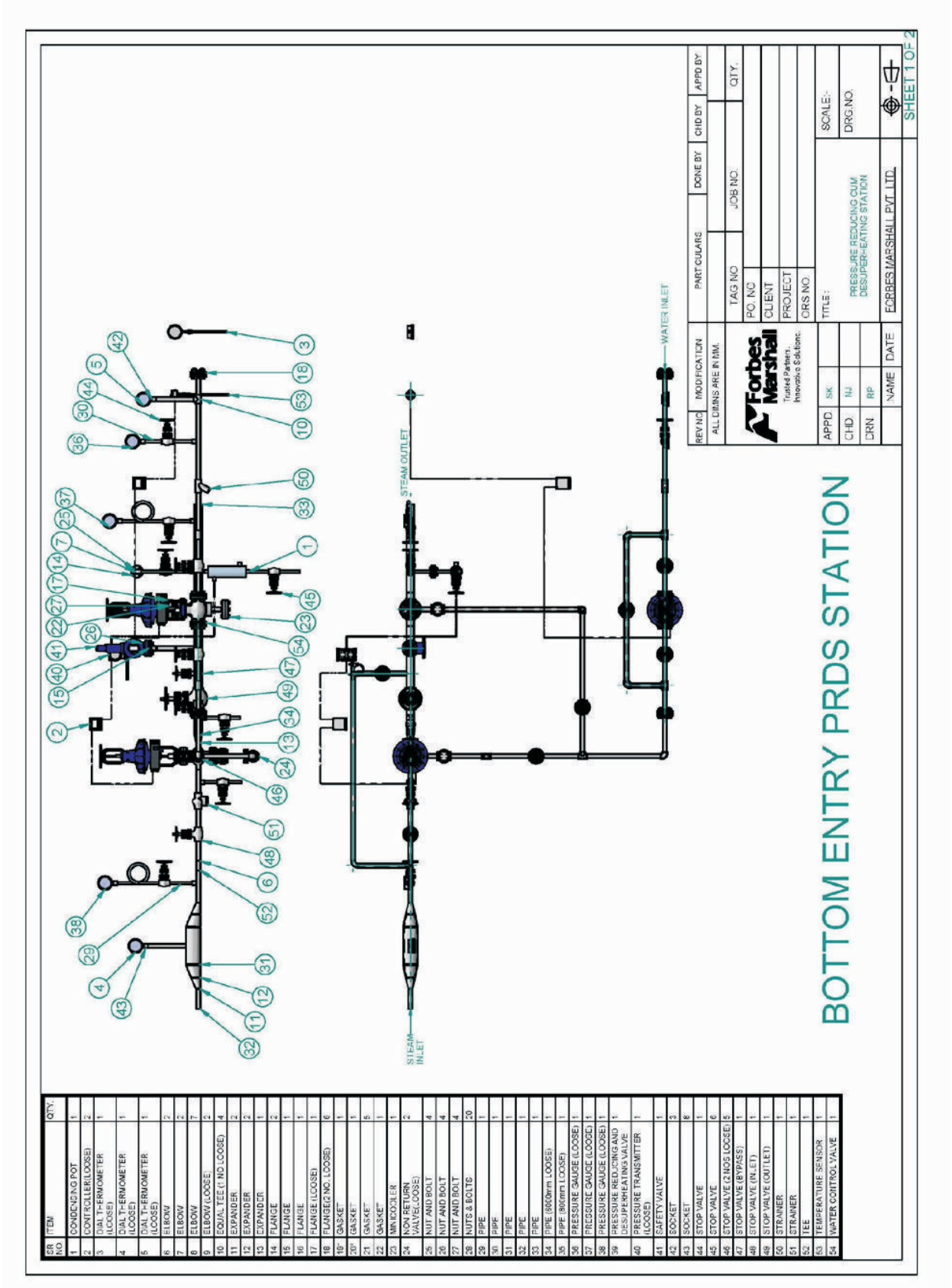

PRESSURE REDUCING STATION WITH POSITIONER

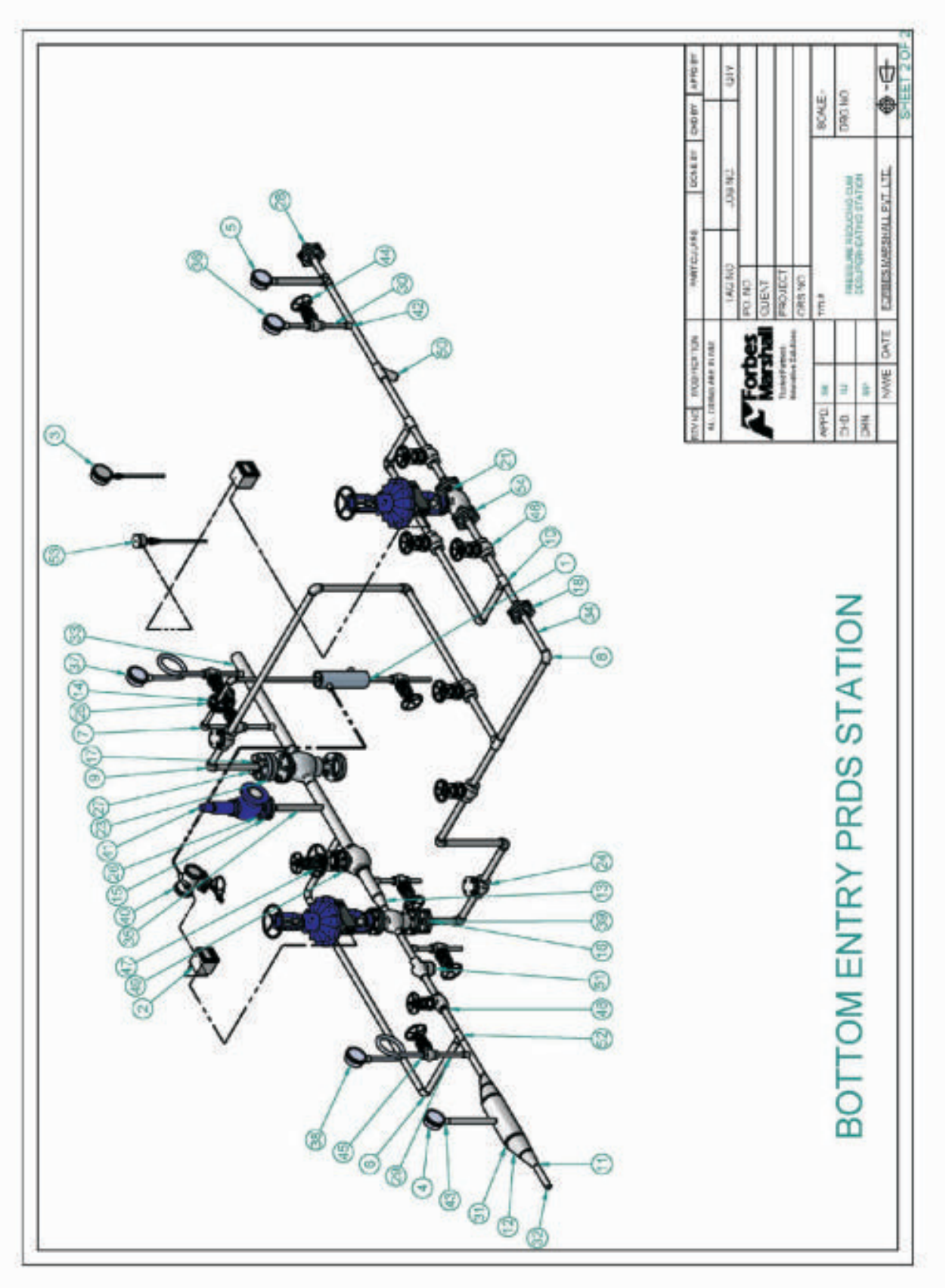

STEAM OUTLET
STEAM INLET
PRESSURE REDUCING STATION WITH ROBOTER

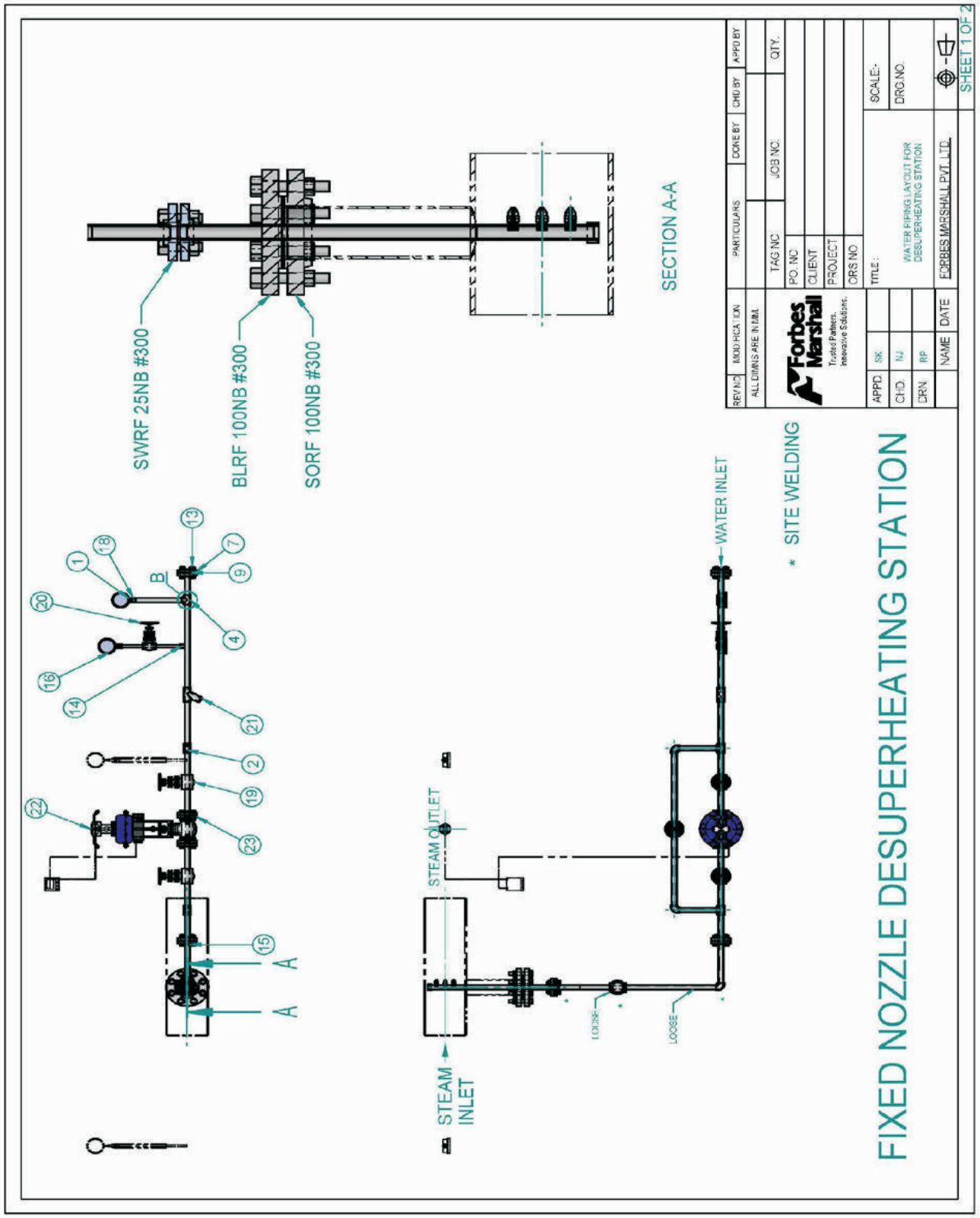

PRESSURE REDUCING STATION WITH ROBOTER

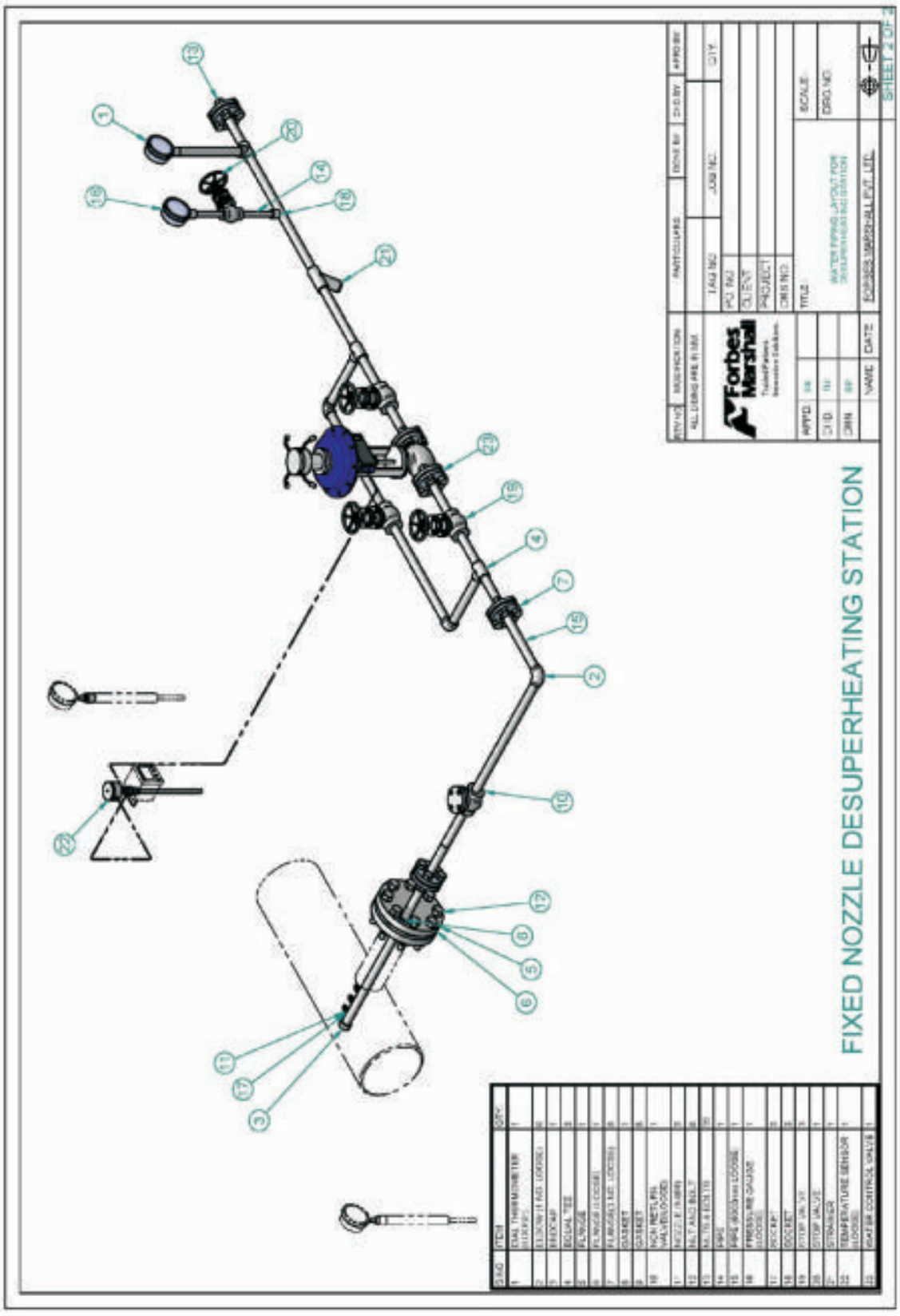

TOP ENTRY PRDS STATION
SECTION B-B
SECTION A-A
STEAM OUTLET
STEAM INLET
WATER INLET
SITE WELDING
SWRF 25NB #300
BLRF 100NB #150
SORF 100NB #150
Forbes Marshall

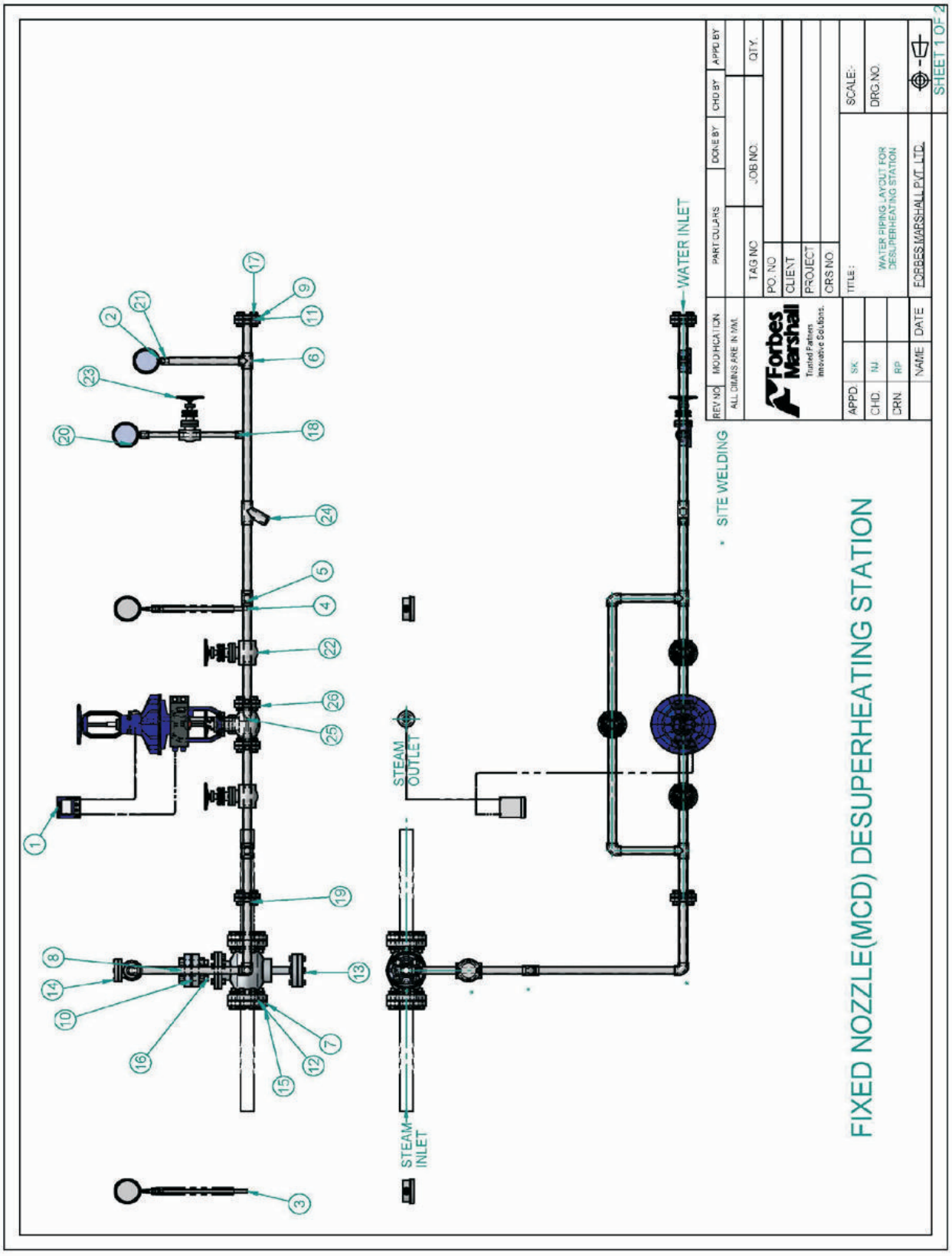

TOP ENTRY PRDS STATION


BOTTOM ENTRY PRDS STATION
STEAM INLET
STEAM OUTLET
WATER INLET
SR NO. | ITEM | QTY.
1 | CONDENSING POT | 1
2 | CONTROLLER(LOOSE) | 2
3 | DIAL THERMOMETER (LOOSE) | 1
4 | DIAL THERMOMETER (LOOSE) | 1
5 | DIAL THERMOMETER (LOOSE) | 1
6 | ELBOW | 2
7 | ELBOW | 2
8 | ELBOW | 7
9 | ELBOW (LOOSE) | 2
10 | EQUAL TEE (1 NO LOOSE) | 4
11 | EXPANDER | 2
12 | EXPANDER | 2
13 | EXPANDER | 1
14 | FLANGE | 2
15 | FLANGE | 1
16 | FLANGE | 1
17 | FLANGE (LOOSE) | 1
18 | FLANGE(2 NO. LOOSE) | 6
19* | GASKET | 1
20* | GASKET | 1
21 | GASKET | 5
22 | GASKET | 1
23 | MINICOOLER | 1
24 | NON RETURN VALVE(LOOSE) | 2
25 | NUT AND BOLT | 4
26 | NUT AND BOLT | 4
27 | NUT AND BOLT | 4
28 | NUTS & BOLTS | 20
29 | PIPE | 1
30 | PIPE | 1
31 | PIPE | 1
32 | PIPE | 1
33 | PIPE | 1
34 | PIPE (800mm LOOSE) | 1
35 | PIPE (800mm LOOSE) | 1
36 | PRESSURE GAUGE (LOOSE) | 1
37 | PRESSURE GAUGE (LOOSE) | 1
38 | PRESSURE GAUGE (LOOSE) | 1
39 | PRESSURE REDUCING AND DESUPERHEATING VALVE | 1
40 | PRESSURE TRANSMITTER (LOOSE) | 1
41 | SAFETY VALVE | 1
42 | SOCKET | 3
43 | SOCKET | 8
44 | STOP VALVE | 1
45 | STOP VALVE | 6
46 | STOP VALVE (2 NOS LOOSE) | 5
47 | STOP VALVE (BYPASS) | 1
48 | STOP VALVE (IN-LET) | 1
49 | STOP VALVE (OUTLET) | 1
50 | STRAINER | 1
51 | STRAINER | 1
52 | TEE | 1
53 | TEMPERATURE SENSOR | 1
54 | WATER CONTROL VALVE | 1
REV NO. | MODIFICATION | PART CULARS | DONE BY | CHD BY | APPD BY
ALL DIMNS ARE IN MM.
TAG NO
PO. NO
CLIENT
PROJECT
ORS NO.
JOB NO.
QTY.
Forbes Marshall
Trusted Partners. Innovative Solutions.
APPD SK
CHD NJ
DRN RP
NAME DATE
TITLE :
PRESSURE REDUCING CUM DESUPERHEATING STATION
FORBES MARSHALL PVT. LTD.
SCALE:-
DRG.NO.
SHEET 1 OF 2


BOTTOM ENTRY PRDS STATION
Forbes Marshall
SHEET 2 OF 2


FIXED NOZZLE DESUPERHEATING STATION
SECTION A-A
SWRF 25NB #300
BLRF 100NB #300
SORF 100NB #300
WATER INLET
STEAM OUTLET
STEAM INLET
* SITE WELDING
LOOSE
LOOSE
WATER PIPING LAYOUT FOR DESUPERHEATING STATION
FORBES MARSHALL PVT. LTD.
SHEET 1 OF 2


FIXED NOZZLE DESUPERHEATING STATION


FIXED NOZZLE(MCD) DESUPERHEATING STATION
WATER INLET
STEAM OUTLET
STEAM INLET
SITE WELDING
Forbes Marshall
Trusted Partners Innovative Solutions.
REV NO
MODIFICATION
PART CULARS
DONE BY
CHD BY
APPD BY
ALL DIMNS ARE IN MM.
TAG NO
JOB NO:
QTY.
PO. NO
CLIENT
PROJECT
CRS NO
TITLE :
WATER PIPING LAYOUT FOR DESUPERHEATING STATION
SCALE:-
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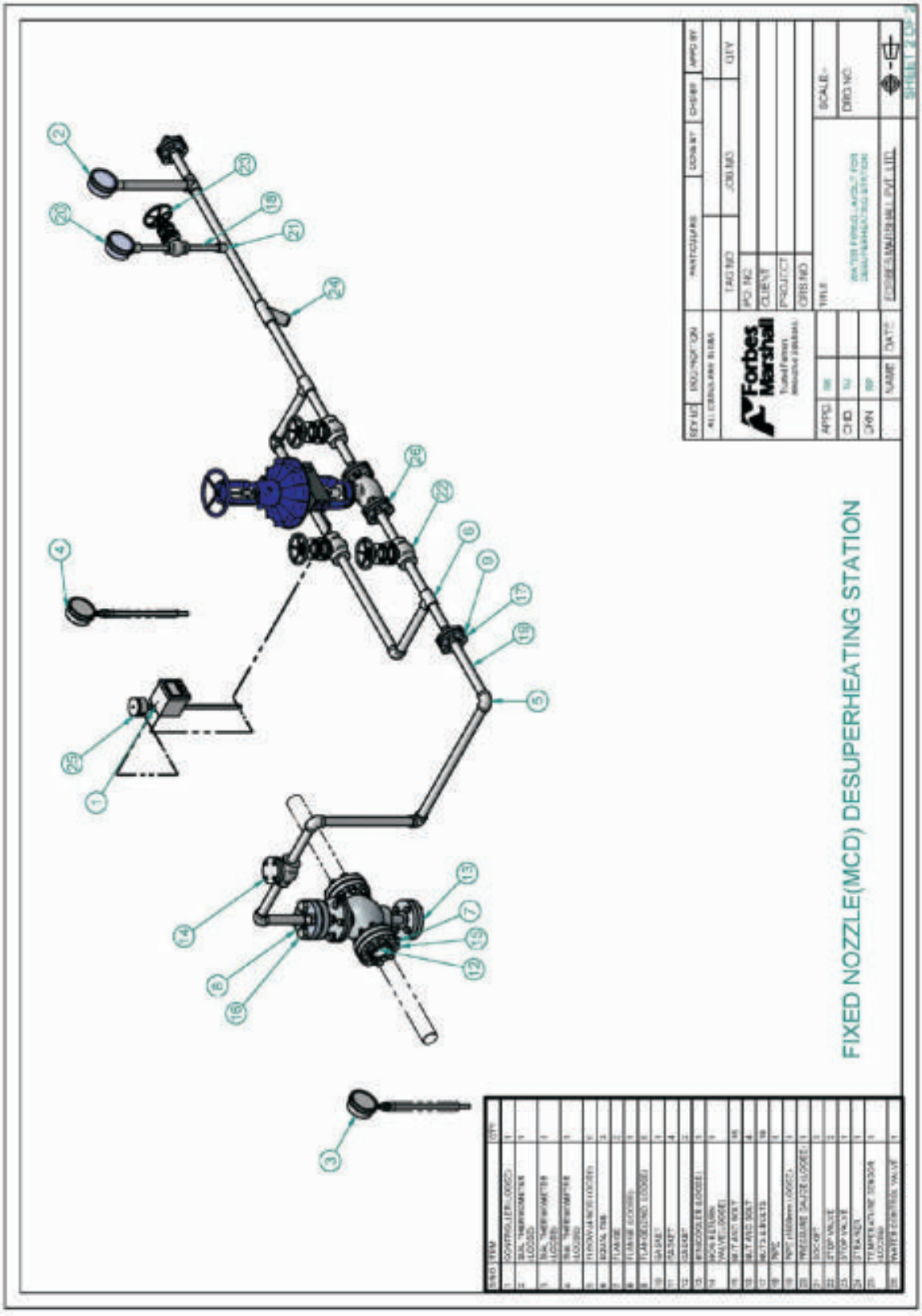
DRN RP
NAME
DATE
FORBES MARSHALL PVT. LTD.
SHEET 1 OF 2


FIXED NOZZLE(MCD) DESUPERHEATING STATION

Forbes Marshall

Field Service Report

Report # : Date

Division

1) Customer Information

Customer Name :

Address :

Site :

Contact person : Phone :

Reference :

2) Product Information

Product Description :

Serial Number : Original Invoice # : Date

Input / Inlet Details :

Output / Outlet Details :

The Product is ☐ Online ☐ Offline

Connections ☐ Flanged ☐ Screwed ☐ Welded

Mounting Details :

3) Application Information

Process Media :

Pressure : Temperature :

Sensor Details :

Mounting Details :

4) Observed Problems or Symptoms

5) Proposed Action

Repair at Site ☐ Return to Works ☐ Estimate First or Under Warranty

Field Engineer's Sig. Customer's Signature :

6) To be Filed in for Estimate Purposes

Estimated cost :

List any imported spares which must be provided by Customer

Signature of MFG / CSD Engineer.

7) Customer's Endorsement

We accept the above repair estimate.

Signature & Stamp

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Operation and Installation Manual

FIXED NOZZLE DESUPERHEATING STATION (DSH)

Energy Conservation | Environment | Process Efficiency

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INSTALLATION

A fixed nozzle desuperheater in conjunction with the cooling water control valve and temperature loop reduces the superheat of inlet steam and thereby the temperature. The low temperature steam can then be used for other processes and utilities

While installing a Fixed nozzle desuperheater, following need to be taken care of :

1. Before installing the nozzle insert in the steam pipe, the water circuit needs to be thoroughly flushed with the designated water pressure for 25 minutes. While flushing, please ensure that the Forbes Marshall Arca water control valve, isolation valves and bypass valve are kept in 100% open condition in case these are of welded connection. In case of flanged bodies, all the valves need be removed from the water circuitry and the line flushed for about 10 minutes.

2. The above activity will ensure that no foreign particles shall enter into the steam line from the water line. This will also avoid any clogging of the nozzles due to impurities and suspended particles present in water

3. Check whether the strainer has become clogged in the cleansing process. In the event of clogging, remove the straining element, clean properly and reassemble strainer

4. Now connect the nozzle insert to the water circuitry (keeping the nozzle insert outside the steam pipe) and flush again for 5 minutes at the designated water pressure and visually inspect the atomization of the water (which should look like a fine fountain)

5. Now install the nozzle insert into the steam pipe.

6. Check the nozzle insert to ensure that the nozzle is at the centre of your steam pipeline. In case of multiple nozzles, please ensure that the central nozzle sprays from the centerline of your pipe. Proper mixing of atomized water with steam ensures efficient temperature control (please make sure that no water is sprayed on the wall of the pipeline, which may result in water carry over which will lead to water hammering and inaccurate temperature control)

7. Perform COLD CHECKING with designated water pressure and temperature after 1 – 6 has been completed. Ensure that no leakage has been observed in the water circuitry

8. Check the pipeline geometry and ensure that there is a MINIMUM AVAILABLE STRAIGHT LENGTH OF 4.5 METERS FROM THE POINT OF SPRAY. (Please install the same steam pipe size for which the fixed nozzle desuperheater has been designed. In case of oversize or undersize of the steaam pipe, the downstream temperature will NOT be maintained resulting in water carry over and water hammering). You can, however, install bends / elbows / tees after a straight length of 4.5 meters

9. The temperature sensor (thermocouple, RTD and temperature transmitter) shall have to be mounted on the steam pipe at a distance of AT LEAST 12 METERS from the point of water injection. The maximum distance of temperature sensor / transmitter location can be 18 – 20 meters from the point of water injection. This is a very important parameter for the temperature control circuitry and it should be followed

COLD CHECKING / LOOP CHECKING

1. The control loop shall be programmed as per the process requirement (single loop controller, multi loop controller, SCADA, PLC and DCS)

2. Check whether proper cabling has been done between the temperature sensor and the controller. Also check whether proper input signals are being received by the controller or not

3. Check whether the controller is giving proportional control output signals or not

4. The controller output signal shall be connected with proper polarity to the I/P or E/P convertor (or electropneumatic positioner of the water control valve, as the case may be for your equipment)

5. Before giving any impulse air connection, the airline shall be flushed for about 5 minutes (depends on the compressor capacity) for any dirt, dust, oil and moisture. The signal air shall be given (through the air filter regulator) to the pneumatic instrument as per recommendation on the control valve name plate. Ensure that no leakage is observed after bubble test

6. After steps 1 – 5 above, set the controller in manual mode, calibrate the water control valve from 0 – 100% (the control range of the control valve will be from 15% to 85% ONLY). Any control range below 15% and above 85% will not contribute to the controllability of the process.

FINAL COMMISSIONING

1. Ensure that the process is put on the manual mode on the low load.

2. Charge the recommended pressure and temperature water into the water circuitry with control valve in closed condition.

3. Charge steam and run the process with designed loads.

4. Manually open the control valve through controller gradually and observe the feedback of the process temperature in the controller.

5. Gradually open the water control valve manually and check the position of opening where the temperature set point is met. Once the temperature set point is met, keep the valve in the same position and make a changeover from manual to auto mode.

6. Once the control system is changed to auto mode, fine tune the P.I.D values for optimum control

7. Observe the process for 1 – 2 hours with variation in loads for the design parameters. Your system is commissioned.

MAINTENANCE

Maintenance of the VND is straightforward and does not require any special tools or training.

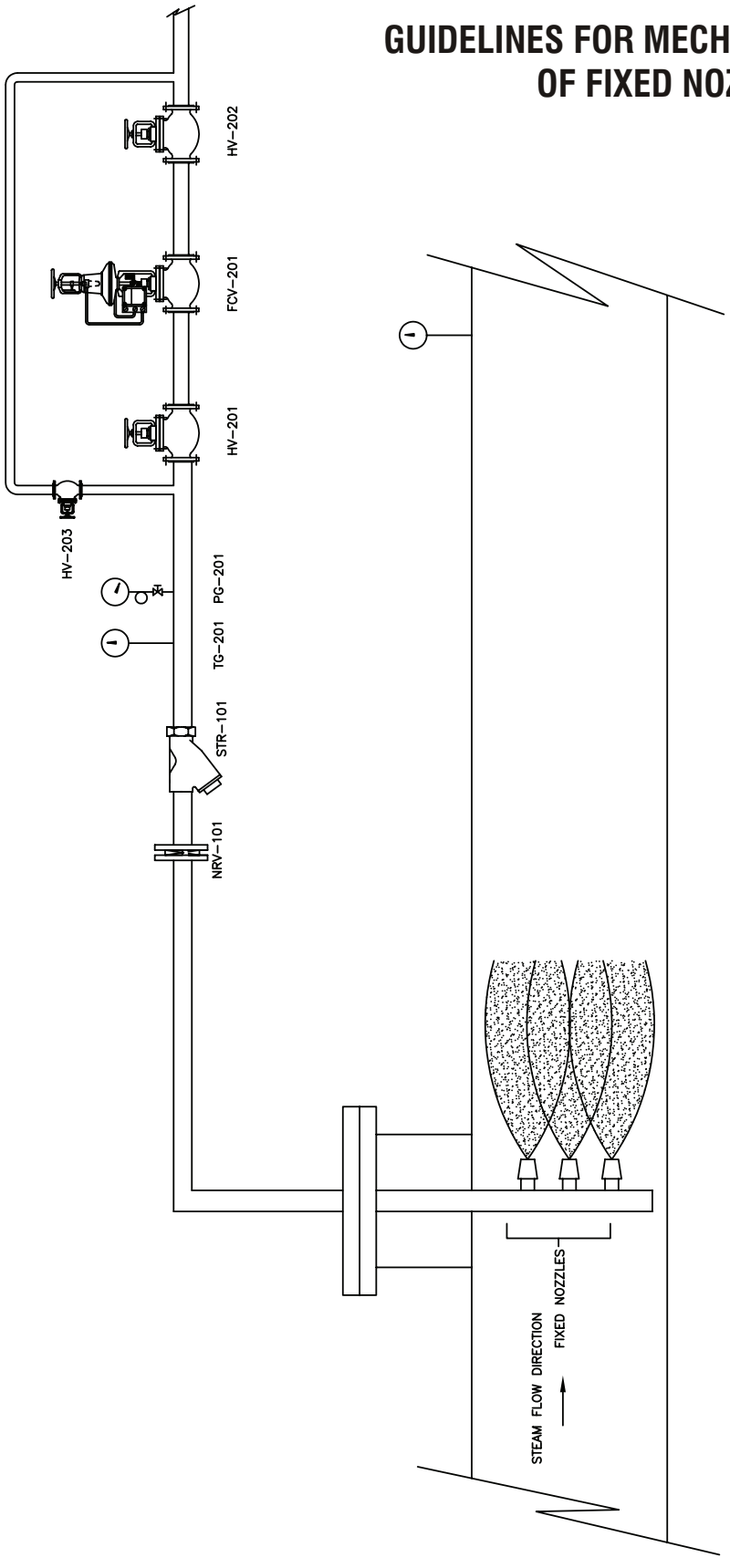
Care should be taken during any maintenance operation, particularly when working with grinders, compressed air and rotating machinery.

Before removing the Desuperheater from the system ensure that both steam and water pipework are pressureless and vented. Isolate any electrical appliances to the actuator and / or ancilliaries, prior to disconnection. Vent and remove instrument air supply piping. Loosen steam flange and water flange bolting, but vent connections before complete removal.

The Desuperheater may now be removed from the system. It is recommended that the Desuperheater is transported to a convenient workshop which has a workbench and vice. Lift the unit by means of straps around the body.

Do not attempt to lift the Desuperheater

GUIDELINES FOR MECHANICAL INSTALLATION OF FIXED NOZZLE DESUPERHEATER



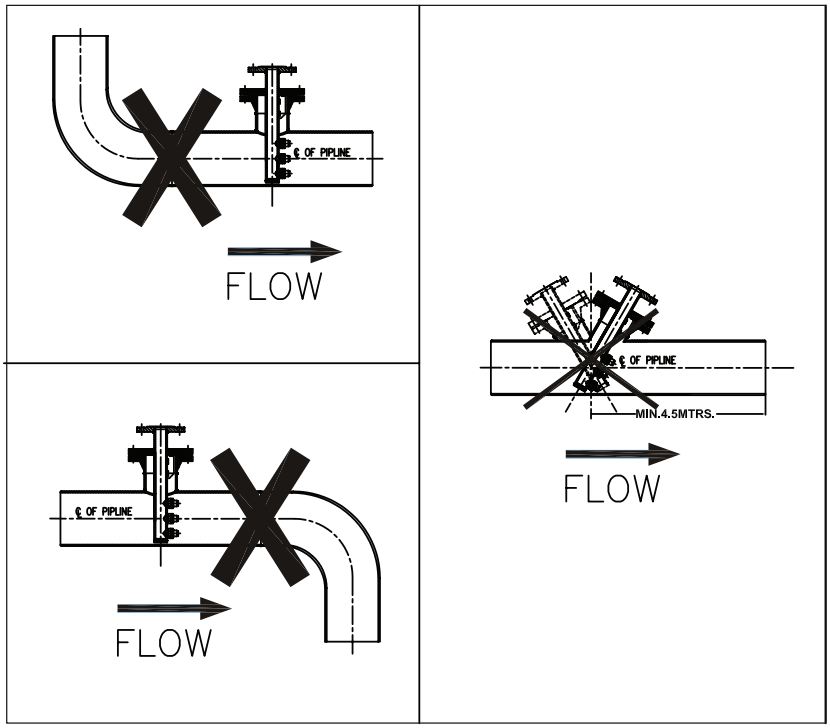
THE IDEAL SCHEMATIC DIAGRAM OF DSH STATION INSTALLATION ON THE FIELD

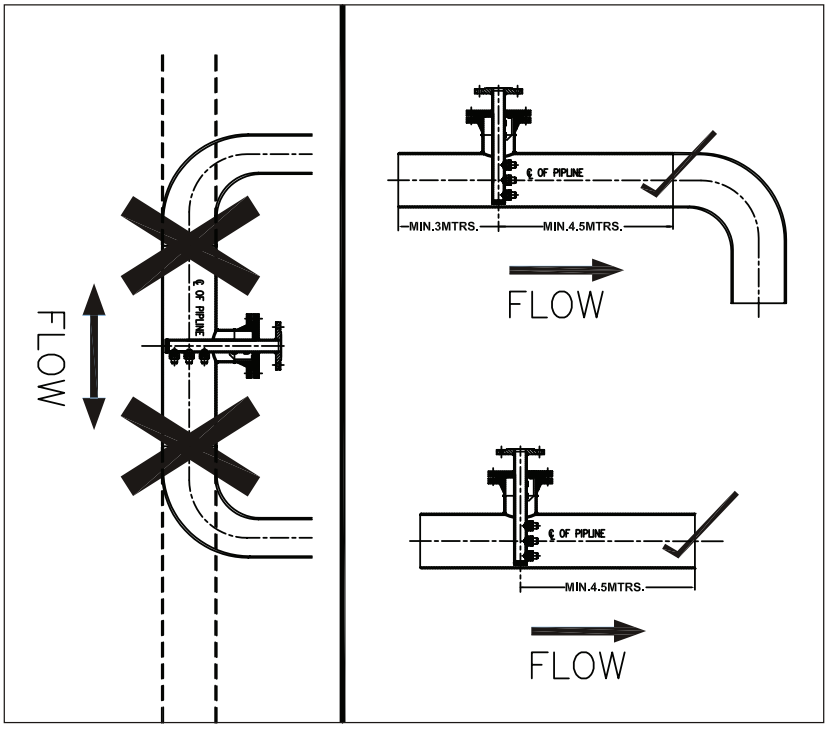
HV-101 TO HV-103 : MANUAL ISOLATION VALVE FOR PRV STATION
FCV-101 : WATER FLOW CONTROL VALVE WITH POSITIONER OF PRV STATION
PG-101 : PRESSURE GAUGE WITH SYPHON & ISOLATION VALVE
TG-101 : DIAL TEMPERATURE GAUGE (OPTIONAL)
NRV-101 : NON RETURN VALVE
STR-101 : STRAINER (MESH SIZE- 0.5MM)

NOTE :

THE MINIMUM 4 METERS STRAIGHT LENGTH AFTER DSH
PG CAN BE INSTALLED AFTER 1.5 MTRS. & ABOVE.
TG CAN BE INSTALLED AFTER 12 MTRS. & ABOVE.
100 MICRONS STRAINER IN THE WATER LINE IS MUST.

CORRECT INSTALLATION METHODS

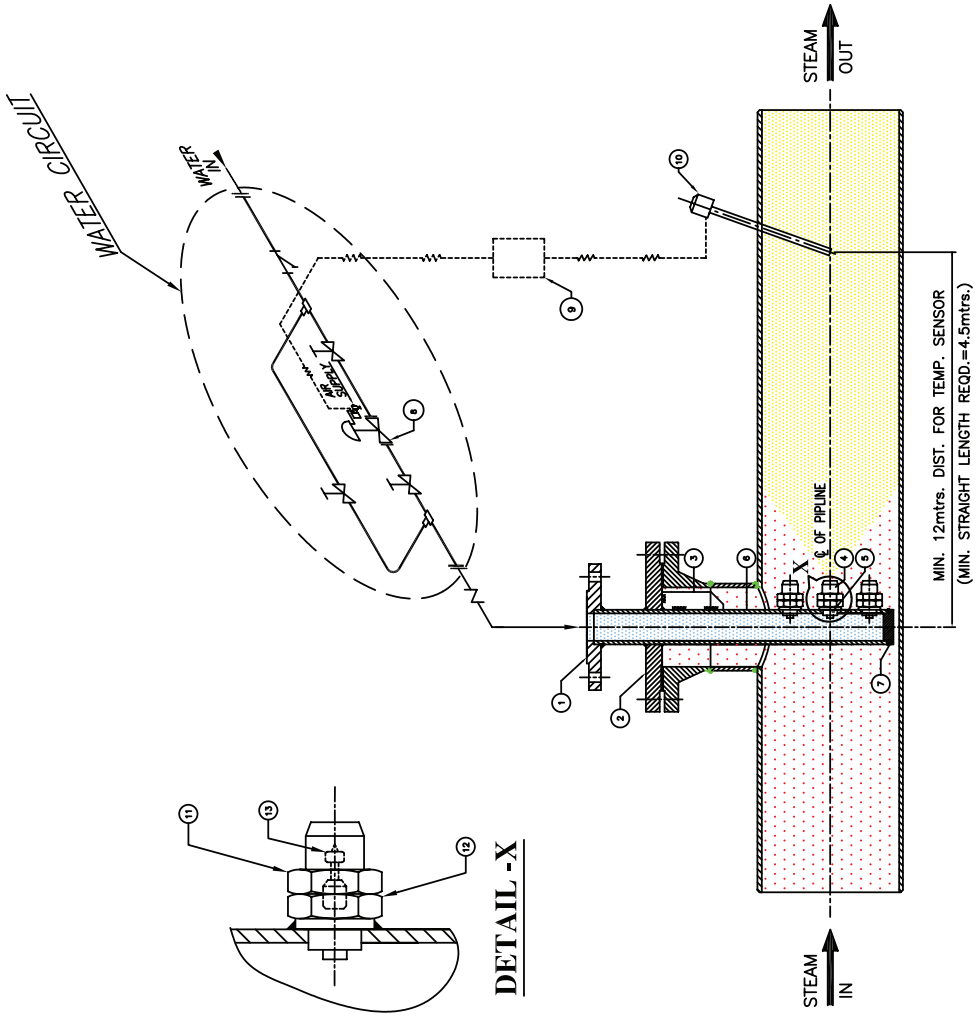




P & I DIAGRAM

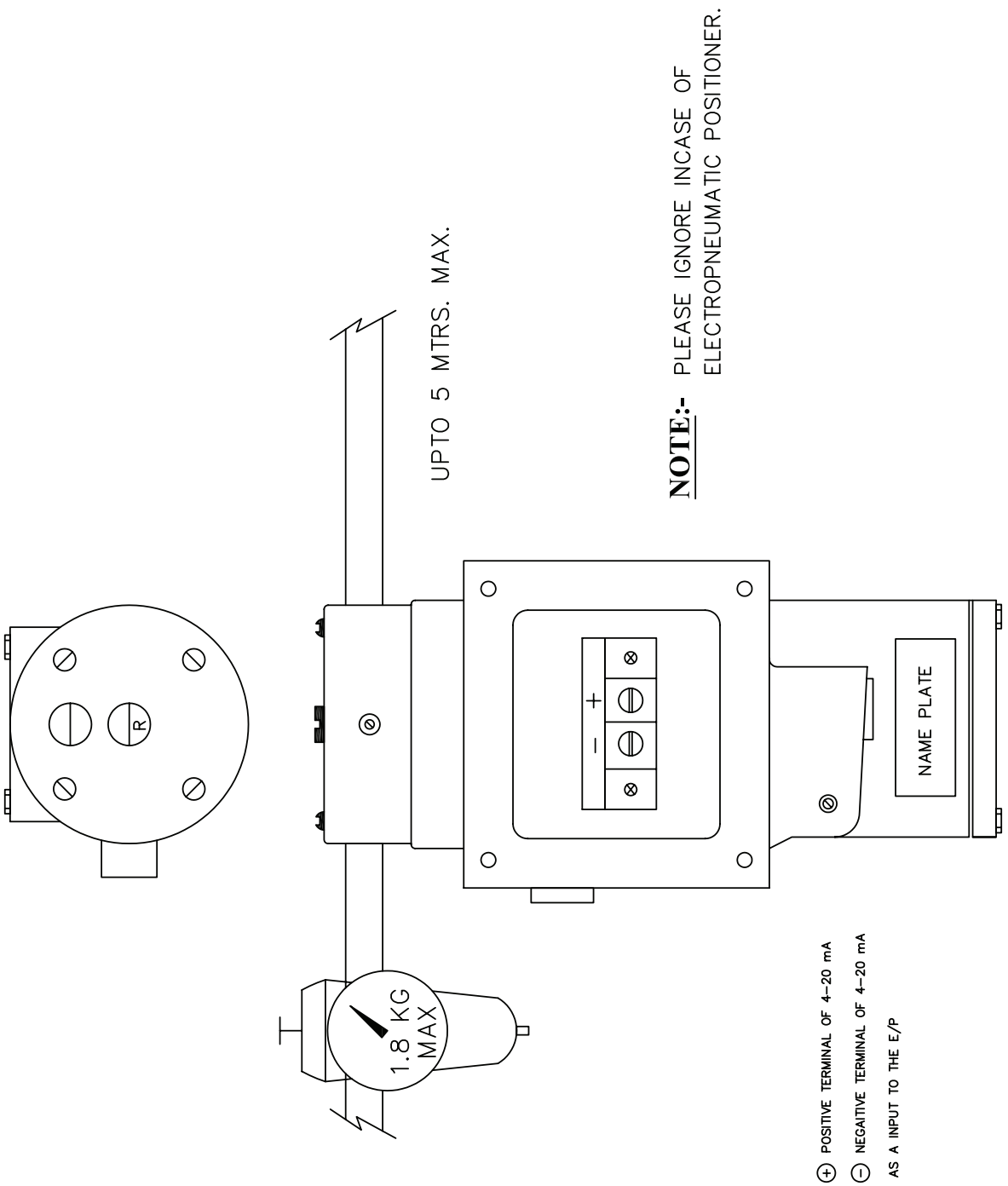
PART LIST

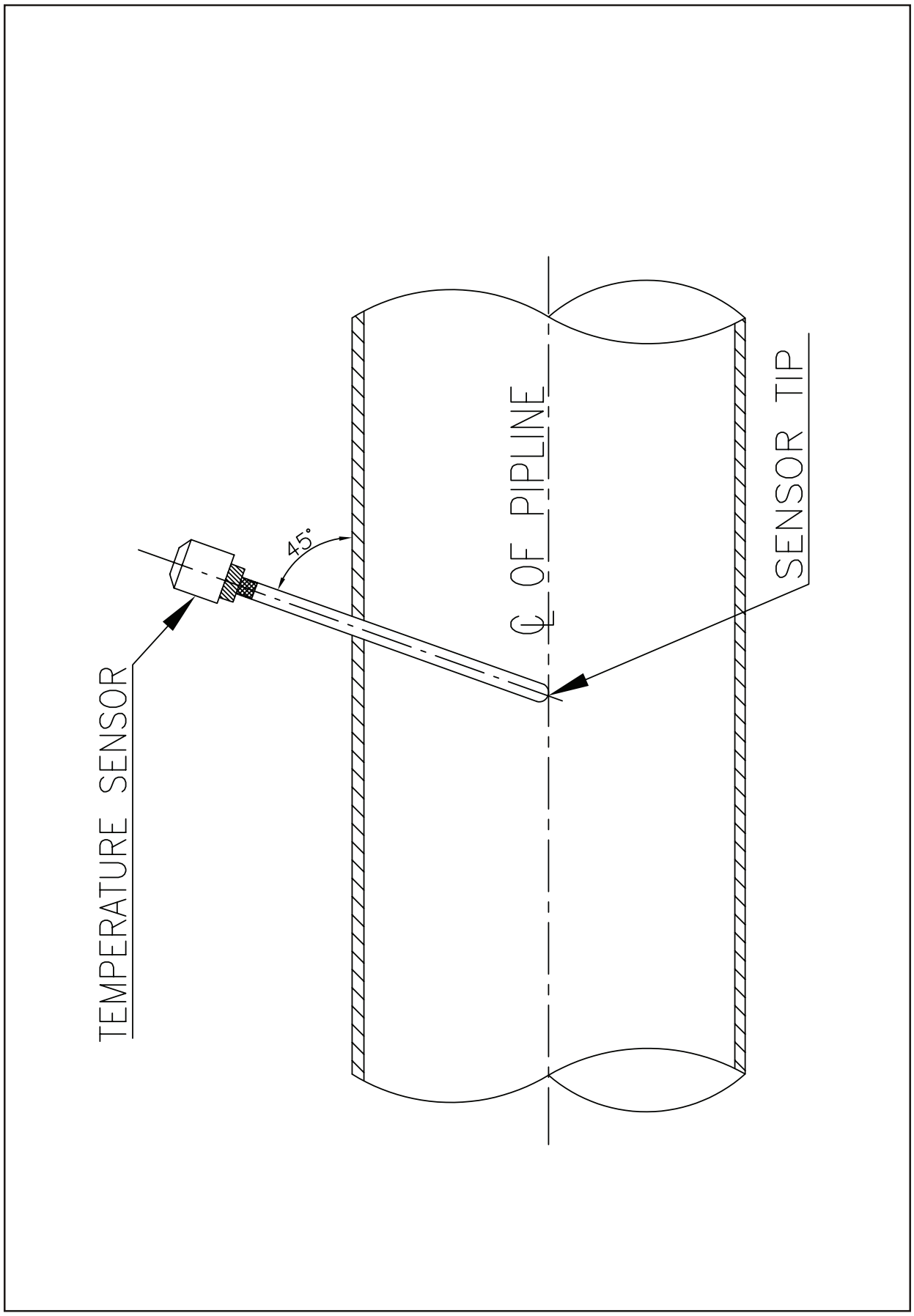
SR.No.	DESCRIPTION
1	WATER SIDE FLANGE
2	STEAM SIDE FLANGE
3	SUPPORT PLATE
4	SPRAY NOZZLE
5	NOZZLE HOLDER
6	NOZZLE PIPE INSERT
7	END PLATE
8	WATER FLOW CONTROL VALVE
9	PID CONTROLLER
10	TEMPERATURE SENSOR
11	INNER BODY
12	OUTER BODY
13	FLOAT PIN



E/P CONVERTER

TYPICAL INSTRUMENTATION
WIRING/PNEUMATIC CONNECTION DIAGRAM




TEMPERATURE SENSOR
45°
℄ OF PIPLINE
SENSOR TIP

NOTES

Check List for Commissioning of the Only De-superheahor.

Sr.No.	Work To be Done.	Completed Yes/No.	If not, by when it will get completed
1	Is the De-superheator station / valve Installed in the line?		
2	Is the Temp Sensor with thermowell installed at around 10 to 12 meters after the de-superheater nozzle / or 10 -12 mtrs after the control valve (if de-superheator water line given to control valve.)		
3	Is the PID controller mounted at proper place?		
4	Is the signal cable laid from Temp sensor up to the PID controller?		
5	Is the signal cable laid from PID Controllers to control valve?		
6	Is the dry air pneumatic lines given up to the AFR of the control valve?		
7	Is the de-superheating water line from pump to water control valve given?		
8	Is the temperature gauges mounted at inlet and outlet of the de-superheator nozzle?		

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Operation and Installation Manual

VARIABLE NOZZLE DESUPERHEATER

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Forbes Marshall

User Manual

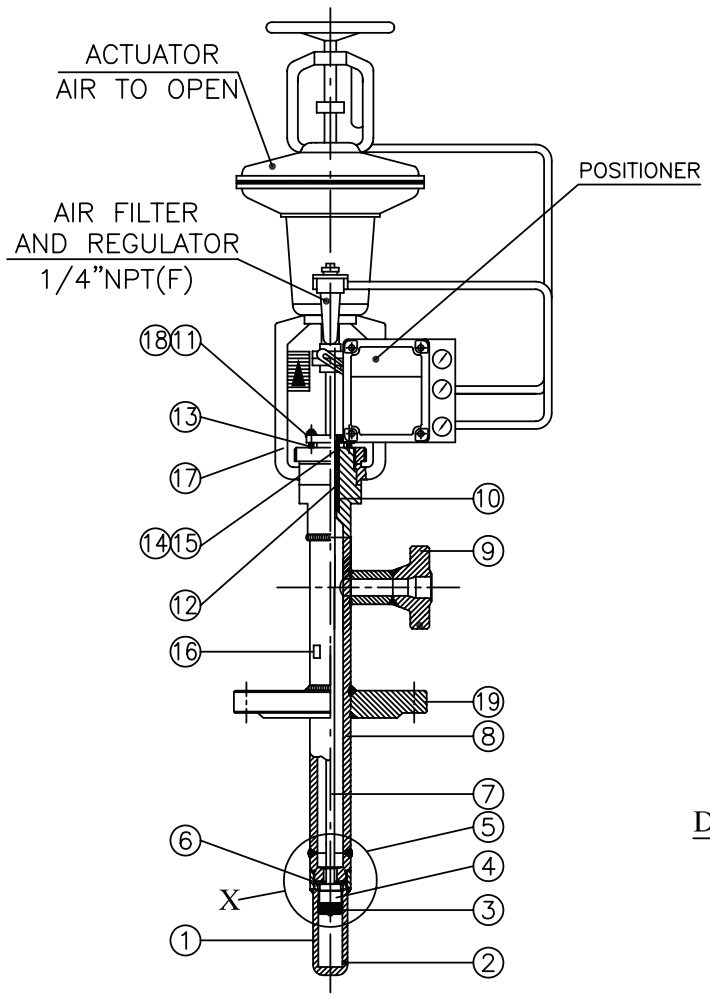
This user manual corresponds to

Variable Nozzle Desuperheater Model 38/48

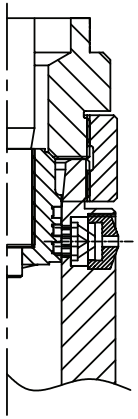
Dear User,

Thank you for purchasing the Forbes Marshall Variable Nozzle Desuperheater. To maximize your benefits from this product, we request that you read this manual thoroughly before installing the desuperheater.
A record of the product maintenance history should be kept in this manual Service Record every time our service representative visits you.

Manufactured and Marketed by
Forbes Marshall Pvt. Ltd.
A Forbes Marshall Company
A 34/35, MIDC Estate,
"H" Block, Pimpri,
Pune - 411 018
INDIATEL. : 91 (0) 20 - 27442020
FAX : 91 (0) 20 - 27442040
Email : vsales@forbesmarshall.com



TYPICAL VND



DETAIL-X

BILL OF MATERIAL

SR. NO.	DESCRIPTION
1	SPRAY CYLINDER
2	NOZZLE ASSLY.
3	PISTON RING (3)
4	PISTON
5	FASTENER RING
6	SEAT
7	STEM
8	BODY
9	WATER FLANGE
10	SPACER

SR. NO.	DESCRIPTION
11	NUT
12	PACKING SET
13	STUD
14	GLAND
15	PLATE
16	NAME PLATE
17	NUT
18	SECURING WASHER
19	BODY FLANGE

Installation of the Model 38/48 Desuperheater

Before installation, check the desuperheater, actuator and accessories for any visible damage. Any damage to your unit should immediately be reported to M/s Forbes Marshall Pvt Ltd.
Check that the information on the documentation, identification plate and tag number complies with the ordered specifications.Remove the Model-38/48 desuperheater carefully from its packaging, lifting by means of straps around the body or use of hoisting lug, if provided. Do not use the water inlet connection, yoke, actuator or any of its accessories for lifting purposes. Leave the flange covers in place during transportation, until ready to install in pipework.

When installing the Model-38/48 desuperheater use gaskets and bolting material in accordance with the relevant piping code. Place the gasket onto the mounting flange and carefully insert the nozzles into the branch pipe. Ensure that the spray cylinder is pointed in the direction of the steam flow before tightening the mounting bolts.

Note : The desuperheater shall be free from 'Forces, Moments and Torques'

The desuperheater is provided with standard lower body length, as specified in the drawing and the mounting branch for the steam pipework must be manufactured to suit. The length of this branch shall be such that the centerline of the spray cylinder is located on the centerline of the steam pipe (+/- 5mm).

The minimum pipe run required downstream of the Desuperheater varies with each individual application and would have been specified by us at the offer stage. The straight run is required to prevent erosion due to impingement of water droplets against pipe walls, valves and other fittings and is normally in the order of 6 Mtrs as a minimum (no upstream straight length is normally required).

The distance from the desuperheater to the temperature sensor is normally 12 Mtrs. Longer distances will ensure that full evaporation of the water will take place at lower steam velocities.

The temperature sensor should be located in the upper half of the pipe, avoid branching of the steam pipework between the Desuperheater and the temperature sensor.

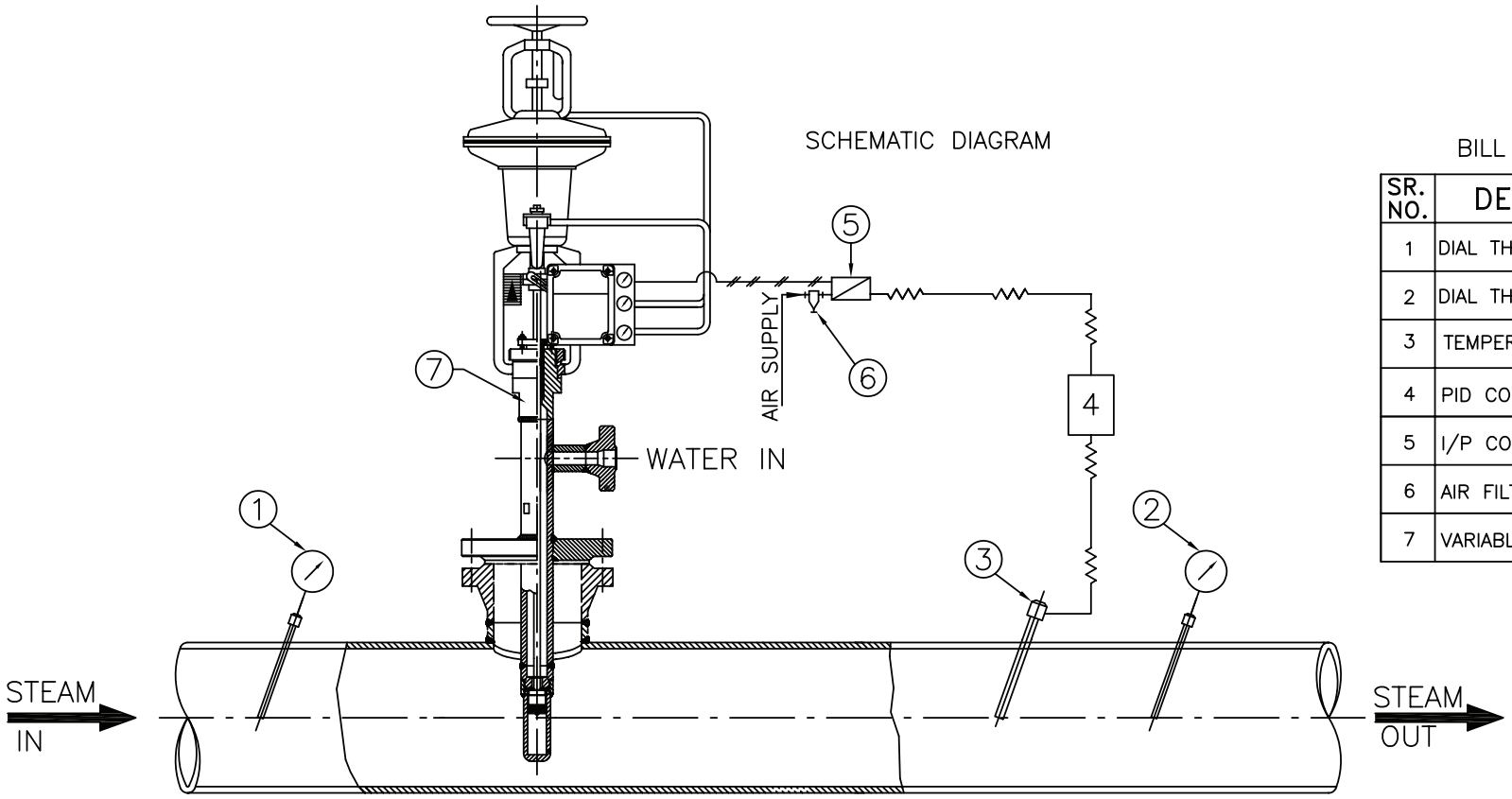
Pipe bends should always be of the long radius type to assist in keeping the water droplets in suspension, until complete evaporation has taken place. Installation may be in vertical or horizontal piping, but the direction of water injection should always be **with** the steam flow.

The Model-38/48 Desuperheater may be mounted at 90 degrees to the steam pipe, for all steam flow orientations, but avoid installation in the vertically downward position under any circumstances.

The water supply shall be of good quality, clean and filtered e. g. boiler feedwater and should have a constant pressure as specified in the order. Each water supply line shall be protected with its own individual strainer with maximum element perforation size of 0.1 mm.

Where there are positive shut off components in the water supply (including electric actuators) then a safety relief valve shall be fitted. As in the case of steam pipework, use gasketting and bolting in accordance with the relevant piping code.

Flush out the water before connecting to the Desuperheater mounting flange.



BILL OF MATERIAL

SR. NO.	DESCRIPTION
1	DIAL THERMOMETER
2	DIAL THERMOMETER
3	TEMPERATURE SENSOR
4	PID CONTROLLER
5	I/P CONVERTER
6	AIR FILTER AND REGULATOR
7	VARIABLE NOZZLE DESUPERHEATER (VND)

TOTAL DESUPERHEATING SYSTEM ALONG WITH CONTROL LOOP

Start Up

Ensure that all components are installed correctly. Connection of electrical appliances and instrument air pipings shall be in accordance with the manufacturer's operation manual. Verify and adjust, if necessary, setpoints for filter regulators and valve positioners, following Forbes Marshall Arca recommendations. Similarly calibrate the temperature transmitter /controller verifying automatic responses to temperature changes.

Warm up the steam main and open the valve in the water supply. Check the water pressure at the Desuperheater. Verify the operation of the temperature transmitter and controller by manually *increasing* and *decreasing* the output signal and observing indicated and recorded temperatures.

When satisfactory coordination between the instrument signals and temperatures is attained, adjustment of the set point can be made and the system transferred to *automatic* operation. It is advisable to record the various steam coordinates over a sustained period, to verify the operation and adjusting, if necessary.

Maintenance

Maintenance of the Forbes Marshall Arca Desuperheater Model-38/48 is straightforward and **does not** require any special tools or *training.*

Care should be taken during any maintenance operation, particularly when working with grinders, compressed air and rotating machinery.

Before removing the Desuperheater from the system ensure that both *steam* and *water pipework* are pressureless and **vented**. Isolate any electrical appliances to the actuator and / or ancilliaries, prior to disconnection. **Vent** and **remove** *instrument air supply piping*. Loosen steam flange and water flange bolting, but vent connections before complete removal.

The Desuperheater may now be removed from the system. It is recommended that the Desuperheater is transported to a convenient workshop which has a workbench and vice. Lift the unit by means of straps around the body. Do not attempt to lift the Desuperheater

Disassembly

The variable nozzle desuperheater can be disassembled, most easily when in the horizontal position with the body **extension clamped firmly** in the vice. Grind off the nozzle tack welds, using standard type of angle grinder. Make sure that the weld is removed sufficiently to allow rotation of the fastener ring without fouling.

Unscrew the fastener ring by rotating **anti-clockwise.** Note that the threading on the **body** extension is *right-handed*. Tapping the fastener ring with a hammer may facilitate removal. Note that the **threading** on the **spray cylinder** is *left handed.* If difficulties are encountered with the removal of the fastener ring, then this item may be removed by grinding through at two diametrically opposite points. Exercise great care not to damage the body and the spray cylinder threadings. (see fig. 4)

Spray Cylinder

Once removed, inspect the condition of the cylinder internally, using a flash light. Scratches and blemishes may be removed by either polishing or honing. The cylinder bore should not exceed 32 mm with a maximum eccentricity of 0.25mm. Any debris can be removed from the nozzles by blowing through with compressed air. Inspect the nozzles atomizer outlet holes. These should not show any undue elliptical wear, roughness or damage or this will have a detrimental effect on the Desuperheater performance. Carefully clean the cylinder threading, dressing where required, with a small file.

Piston Assembly

Withdraw the piston and the stem. The piston and the stem are always supplied as a complete assembly. If the piston shows no sign of wear and tear, then it may be reused. Replace piston rings was a matter or course, any time that the unit is disassembled. Take care not to overstress the piston rings when fitting. The rings are marked "Top" and should always face the direction of the stuffing box, for proper functioning. Examine the condition of the stem, where it runs in the stuffing box, remove any graphite with a fine grade of emery cloth, polishing in the longitudinal direction.

Stuffing box

Remove all the rings, lantern rings and packing material from the valve body. Clean the stuffing box carefully, using a rotating wire brush and / or honing device. Cleanliness of the packing area is vital for proper valve sealing. (see fig b)

Reassembly

Before reassembling the valve, lubricate all threads with a suitable high temperature nickel compound. Do not use grease or other oil based lubricants as these may lead to dismantling problems later. Apply a thin coating of the compound to the piston rings to prevent scoring. Position the slots in the piston rings such that they are 120 degrees to each other.

Reassemble the spray cylinder onto the body extension. Use a fine grade polishing paste to lap the seating area of *cylinder* and *body extension.* The seal is **metal to metal** so a concentric seat area is vital. Always use a new fastener ring. Set the spray cylinder into the correct orientation (the water spray should always be in the same direction as the steam flow) and tighten the fastener ring.

Tack welding

After reassembly, the spray cylinder should be tack welded for added security. It is essential that this welding is carried out by a competent welder. A minimum of two 8mm long tacks are required, diametrically opposite, with one weld securing the fastener ring to the body extension and the other securing the spray cylinder to the fastener ring. After welding, use suitable dye penetrant method to check the weld. No cracks are permitted. If necessary, grind off, recheck until a satisfactory weld is obtained.

Reinstallation

Refit the actuator into the *Desuperheater,* referring to the notes taken during disassembly, for resetting the stem position. If the actuator is electric, check whether the limit switches are functioning correctly by manual operation of the unit. Set at mid stroke before applying power and verify that opening and closing directions are correct and correspond with system logics.

Before reinstalling the Desuperheater, make sure that the connecting flange faces are cleaned thoroughly and any gasketing material removed. Insert the desuperheater into the steam pipe work and check that the nozzle is oriented correctly with the **spray in the direction of the steam flow**. Apply a high temperature lubricating compound to the bolts and nuts and tighten evenly, in accordance with the manufacturer's recommendations. Before connecting the water line, flush through and check for any contamination or restriction in the supply.

Follow the procedure for **Start Up**, as detailed earlier in the installation instructions. Check the flange and stuffing box tightness. Do not over tighten the stuffing box packing gland as this may prevent proper operation of the

desuperheater. In the event of persistent leakage through the stem packing, then the unit should be removed to the workshop for further examination. Experience shows that providing the stuffing box, packing and steam are clean and score free, then leak tightness is achieved.

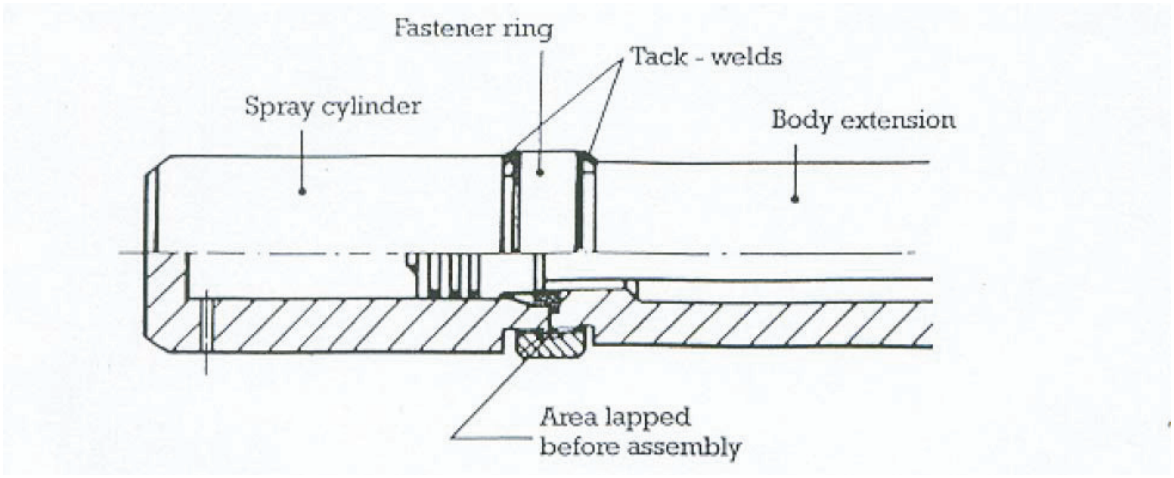
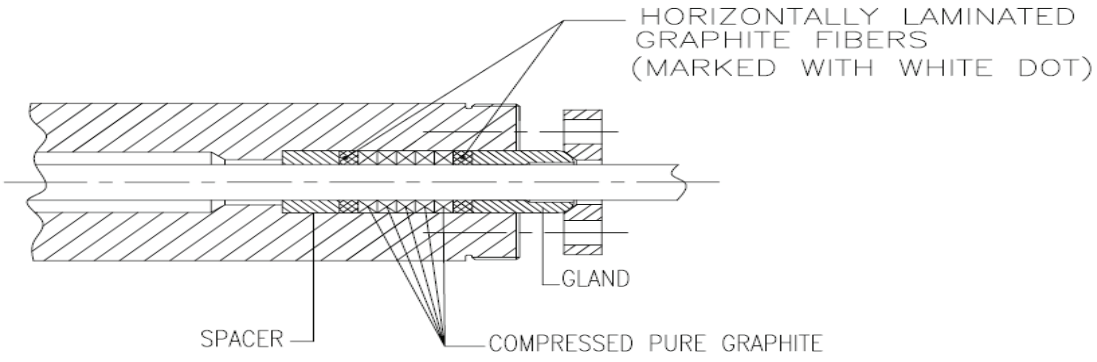


Figure a



STUFFING BOX

Figure b

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Operation and Installation Manual

CONTROL AND PRDS VALVE

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Forbes Marshall

User Manual

This user manual corresponds to

Control valves and Combined Pressure reducing and desuperheating valves

User's Manual

FORBES MARSHALL CONTROL VALVE

This user manual Corresponds to

Control valve model series 100, 140, 160,
Universal Diaphragm Actuator and Multi Spring Actuator.

If you experience difficulty with the installation or operation of this equipment, please contact our Customer Service representative.

Manufactured and Marketed by
Forbes Marshall Pvt. Ltd.
A Forbes Marshall Company
A 34/35, MIDC Estate,
"H" Block, Pimpri,
Pune - 411 018 INDIA
TEL. : 91 (0) 20 - 27442020
FAX : 91 (0) 20 - 27442040
Email : vsales@forbesmarshall.com

Dear User,

Thank you for purchasing the Forbes Marshall Control Valve. To maximize your benefits from this product, we request that you read this manual thoroughly before installing the valve. A record of the product maintenance history should be kept in this manual Service Record every time our service representative visits you.

SECTION I - Control Valve Assembly

1.0 About The Product
1.1 Specification & Model Nos.
1.2 Drawing of the Product
1.3 Principle of Operation

2.0 Getting Started
2.1 Installation
2.2 Before first startup
2.3 Commissioning the Product

3.0 Maintenance
3.1 General
3.2 Routine maintenance

4.0 Troubleshooting
4.1 Addition of gland packing rings
4.2 Replacement of gland packing rings
4.3 Replacement of seat
4.4 Replacement of plug
4.5 Recommended spares

SECTION II ACTUATORS

1.0 Arca Universal Diaphragm Actuator

1.1 Drawing of the Product
1.2 Principle of Operation

2.0 Getting Started
2.1 General Instruction
2.2 Installation
2.3 Commissioning the Product

3.0 Reversability of Actuator

4.0. Troubleshooting
4.1 Exchange of spares
4.2 Mounting succession
4.3 Recommended spares

5.0 Multi Spring Actuator

5.1 Drawing of the Product
5.2 Principle of Operation

6.0 Getting Started
6.1 General Instructions
6.2 Installation

7.0 Assembly Instructions for MSA
7.1 Actuator Assembly
7.2 Actuator and Support Assembly
7.3 FM Valve and Actuator Assembly

8.0 Reversibility of MSA Actuator

9.0 Trouble Shooting

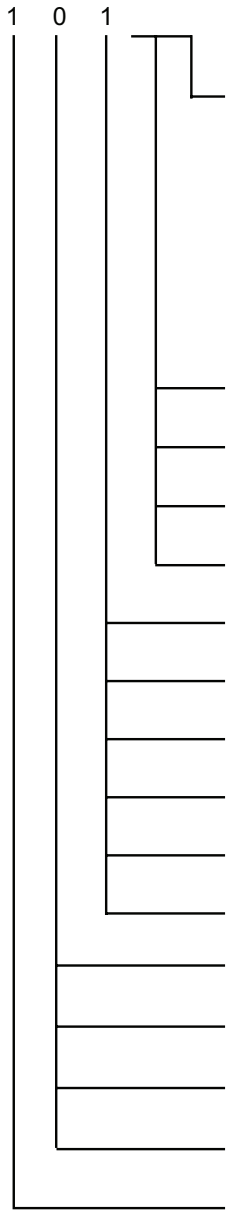
10.0 Tightening Torque

11.0 Spring Location

SECTION - I

1.0 About the Product

1.1 Specifications & Model Numbers



NUMBER OF STEPS FOR

- PARABOLIC PLUG (P)
- PERFORATED PLUG (L)
- LOW NOISE CAGE (LK)
- LOW NOISE DISC (LS)

P : 1 OR SEVERAL STEPPED PARABOLIC PLUG

L : 1 OR SEVERAL STEPPED PERFORATED PLUG

LK : 1 OR SEVERAL STEPPED LOW NOISE CAGE

LS : 1 OR SEVERAL STEPPED LOW NOISE DISC

1 : STANDARD TOP FLANGE

2 : TOP FLANGE WITH DOUBLE GLAND PACKING

3 : TOP FLANGE WITH COOLING FINS

4 : TOP FLANGE WITH BELLOW SEALING

7 : STANDARD TOP FLANGE AND PRESSURE BALANCING

8 : TOP FLANGE WITH COOLING FINS AND PRESSURE BALANCE

0 : NOMINAL PRESSURE # 150, # 300 TOP GUIDED PLUG

1 : NOMINAL PRESSURE # 600-1500 TOP GUIDED

4 : NOMINAL PRESSURE # 300 TOP & BOTTOM GUIDED

6 : NOMINAL PRESSURE # 600-1500 TOP & BOTTOM GUIDED PLUG

1 : SINGLE SEAT CONTROL VALVE

This manual is applicable to the following valve model nos. :

100, 140, 160 The code nos. are given above. for eg. valve with model no. 1 6 1. L2

SINGLE SEAT CONTROL VALVE NOMINAL PRESSURE # 600-1500

STANDARD TOP FLANGE WITH TWO STEP PERFORATED PLUG

CONTROL AND ON / OFF VALVES SERIES 140

Control Valve Series 141

1. Valve body
2. Top Flange
3. Bottom Flange
4. Seat
5. Plug
7. Guide bush
8. Spindle
9. Gland nut
10. Gland follower
11. Bottom ring
12. Packing set
13. Slotted nut
14. Spring dowel pin
15. Steel ball
16. Gasket
17. Bolt
18. Nut

on / off valve series 141

1. Valve body
2. Top Flange
4. Seat
5. Plug
7. Guide bush
8. Spindle
9. Gland nut
10. Gland follower
11. Bottom ring
12. Packing set
13. Slotted nut
14. Spring dowel pin
15. Steel ball
16. Gasket
17. Bolt
18. Nut

Control and on / off valve series 141 with soft seating

1. Valve body
2. Top Flange
4. Seat
5. Plug assembly
5.1 Spring dowel pin
5.2 Upper part
5.3 O-ring
5.4 Lower part
7. Guide bush
8. Spindle
9. Gland nut
10. Gland follower
11. Bottom ring
12. Packing set
13. Slotted nut
14. Spring dowel pin
15. Steel ball
16. Gasket
17. Bolt
18. Nut

Top flange with cooling fins series 143

1. Valve body
2. Top Flange
4. Seat
5. Plug assembly
7. Guide bush
8. Spindle
9. Gland nut
10. Gland follower
11. Bottom ring
12. Packing set
13. Slotted nut
14. Spring dowel pin
15. Steel ball
16. Gasket
17. Bolt
18. Nut
19. Low - noise cage

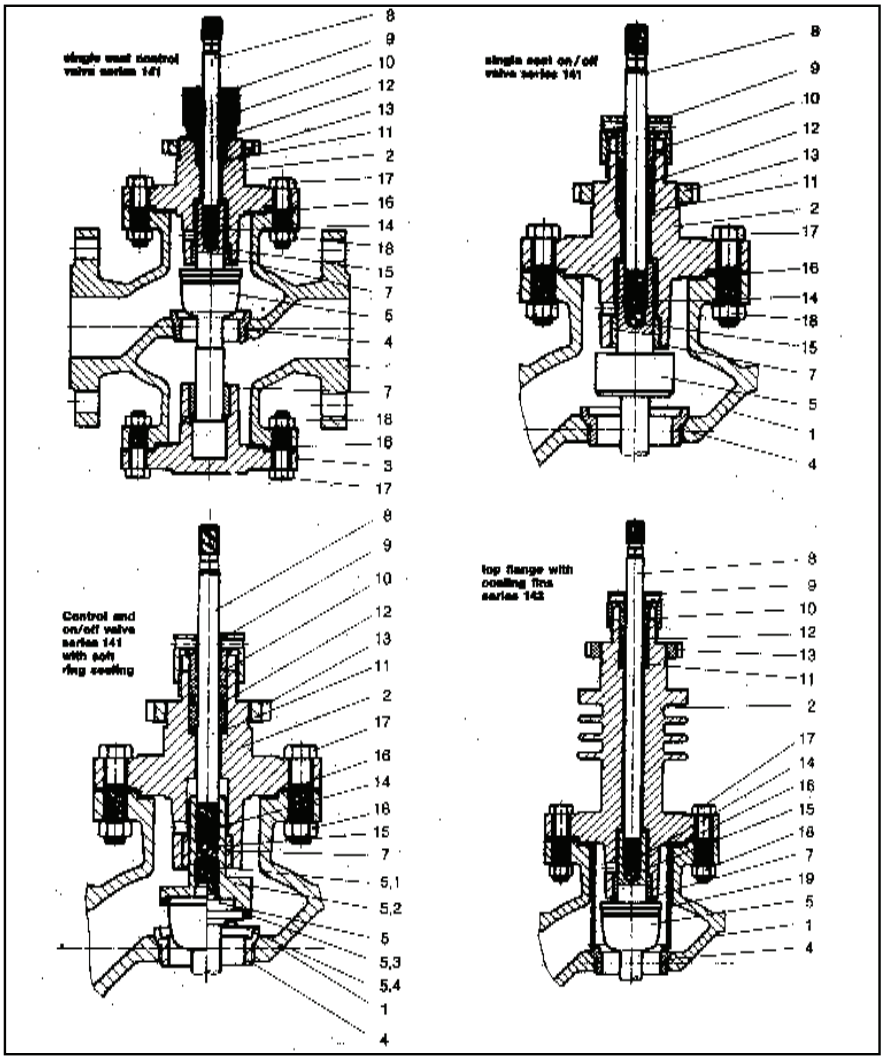

single seat control valve series 141
single seat on/off valve series 141
Control and on/off valve series 141 with soft ring sealing
top flange with cooling fins series 143

FIG. I DRG. 140 AN

CONTROL AND ON / OFF VALVES SERIES 100

Control Valve Series 100

1. Valve body
2. Top Flange
4. Seat
5. Plug
7. Guide bush
8. Spindle
9. Gland nut
10. Gland follower
11. Bottom ring
12. Packing set
13. Slotted nut
14. Spring dowel pin
15. Steel ball
16. Gasket
17. Bolt
18. Nut

on / off valve series 101

1. Valve body
2. Top Flange
4. Seat
5. Plug
7. Guide bush
8. Spindle
9. Gland nut
10. Gland follower
11. Bottom ring
12. Packing set
13. Slotted nut
14. Spring dowel pin
15. Steel ball
16. Gasket
17. Bolt
18. Nut

Control and on / off valve series 101 with soft ring sealing

1. Valve body
2. Top Flange
4. Seat
5. Plug
5.1 Spring dowel pin
5.2 Upper part
5.3 O-ring
5.4 Lower part
7. Guide bush
8. Spindle
9. Gland nut
10. Gland follower
11. Bottom ring
12. Packing set
13. Slotted nut
14. Spring dowel pin
15. Steel ball
16. Gasket
17. Bolt
18. Nut

Top flange with cooling fins series 103

1. Valve body
2. Top Flange
4. Seat
5. Plug
7. Guide bush
8. Spindle
9. Gland nut
10. Gland follower
11. Bottom ring
12. Packing set
13. Slotted nut
14. Spring dowel pin
15. Steel ball
16. Gasket
17. Bolt
18. Nut
19. Low - noise cage

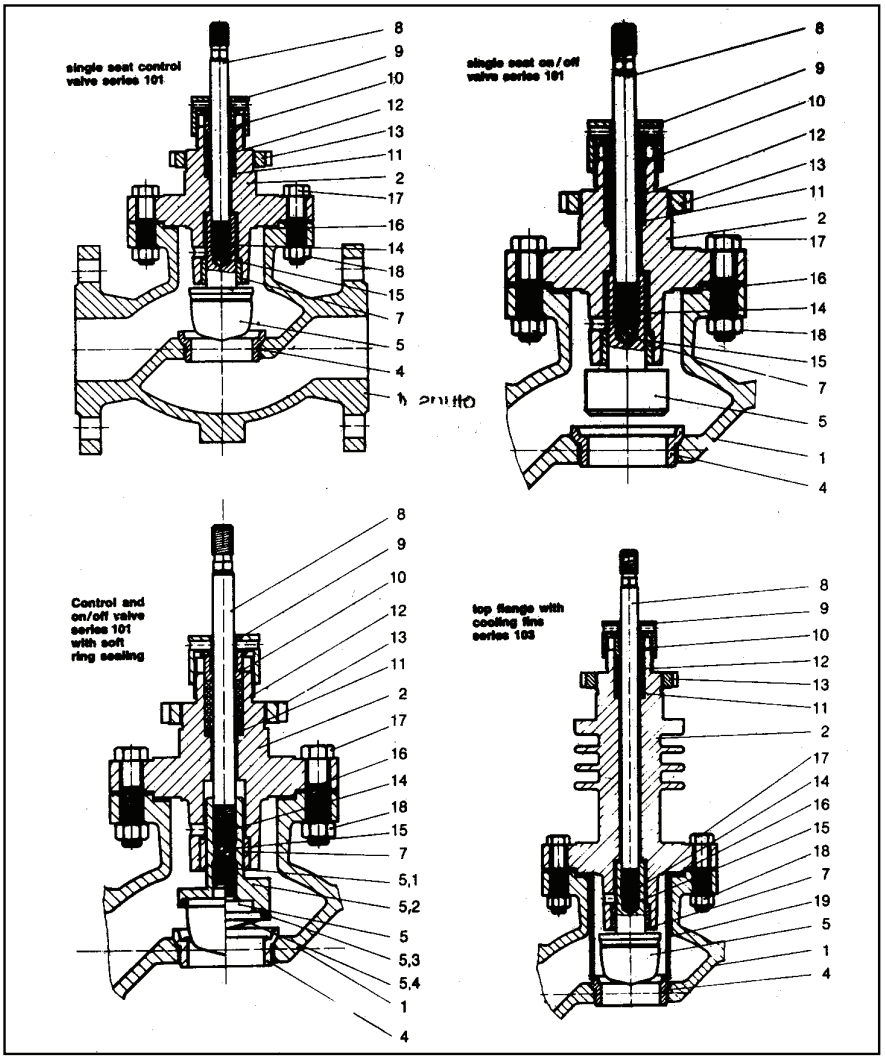

single seat control valve series 101
single seat on / off valve series 101
Control and on/off valve series 101 with soft ring sealing
top flange with cooling fins series 103

FIG. II DRG. 100 AN

1.3 Principle of Operation

The control valve types mentioned above are according to ANSI B 16-34. They reduce the pressure / control flow by single step or multi-step parabolic plug or perforated plug. By changing valve lift (plug position), the annular area between plug and seat changes, which in turn changes the flow. The flow characteristics is determined by the profile or the size and orientation of holes in case of perforated plugs. At zero lift (close position of valve) the plug taper rests on the tapered edge of the seat and thus provides metal to metal closing. In case of multi-step parabolic plugs, only the last-step has taper which rests on the seat in closed position.

2.0 Getting Started

2.1 Installation

The place of installation should be selected to have sufficient valve accessibility around the valve for dismantling and repairs.

Valve size 6” and above should have sufficient space above the valve to mount a chain pulley block.

When valves are mounted in a raised position, a platform should be provided atleast on one side of the valve.

The valve with flanged ends can be directly installed in the pipeline with flanges. The valves with welded ends can be directly welded in the line. In both cases following points must be considered :

a) The valve should be in a horizontal position, with valve spindle in vertical position as shown in the cross section drawing no. 140 - AN and 100-AN.

b) The upstream and downstream piping of the valve should be properly supported to avoid excessive stress on the valve body.

c) Upstream and downstream of the control valves, there should be a straight flow at atleast 10 x valve size (in mm) without any interruption by stop valves, elbows etc.

d) To avoid longer breakdown of the plant a bypass should be installed.

2.2 Before First Start Up

All the mainlines as well as pneumatic air lines must be thoroughly flushed before first commissioning. Following points must be taken care during flushing of these lines :-

a) During flushing, flanged control valves should be taken off the line and replaced by a spacer.

b) If the valve is welded in the line all internal parts including top and bottom flanges have to be removed and top and bottom flanges should be blanked with specially ordered blank flanges. Dismantiling and assembling of the valve internal should be carried out as per 4. (TROUBLE SHOOTING)

c) If the flushing is done with the assembled valve in line the valve must be dismantled and cleaned thoroghly after flushing. Special attention to be given to all the hollow spaces and gaps.

d) Parts which have been corroded by the pickling / cleaning process have to be repaired or replaced. Specially take care of probable leftover of pickling fluid in stuffing box area.

2.3 Commissioning the Product

Please refer to drawing No. 140-AN and 100-AN

a) At the first startup, the gaskets (16) may leak due to setting. If so the nuts (18) should be tightened equally and evenly. Also there may be leakage through gland packing (12) due to setting of packing rings by pressure and temperature effect. Therefore, tighten the gland nut (9) slightly. This tightening of gland nut must be done just sufficient to stop leakage. Excessive tightening will increase friction between packing rings (12) and spindle (8) will result in bad control quality.

b) Control valve in steam line with high temperature should be slowly heated up before startup to avoid thermal shocks.

3.0 Maintenance

3.1 General

The valve spindle (8) must be kept clean in places with bad environmental conditions. The cleaning should be done when the valve spindle is in the upmost position.

3.2 Routine Maintenance

As a part of routine maintenance it is only necessary to retighten the gland nut (9) if any leakage through gland packing starts. Also it may be necessary to tighten the nuts (18) on top and bottom flanges if the gasket (16) leak due to changing pressure and temperature.

4.0 Trouble Shooting

4.1 Addition of Gland Packing Rings

If the leakage cannot be stopped by retightening of the gland nut it will be necessary to add one or two packing rings. For this the valve should be pressureless and drained. Remove the lift indicator coupling. Take the actuator spindle in the uppermost position and lock it there. Unscrew the gladnut and lift the gland follower (10) out. Graphited rings can now be slipped over the spindle and pushed down in stuffing box with the help of gland follower (10).

Endless pure graphite rings can also be carefully cut in two halves and laid around the spindle so that the broken faces match again. Push down the ring in the stuffing box with the help of gland follower. In this case the lift indicator coupling need not be removed. (Refer part No. 53 FIG III SECTION II)

4.2 Replacement of Gland Packing Rings

The valve must be pressureless and drained. Dismantle the lift indicator coupling between valve and actuator spindle.

Unscrew the slotted nut (13) and the actuator can now be taken out. Now loosen the nut (18) of top flange. Uncrew the gland nut (9) and the gland follower (10) can be lifted up. Care should be taken while removing top flange specially in steam and hot gas piping as slight leakage in any stop valve can pressurise the control valve. After ensuring the the valve is pressureless, top flange alongwith plug spindle (8) assembly can be completely taken off the body. Take out the old packing rings (12) with the help of a hook. also take the bottom ring (11) out of the stuffing box.

Clean all the parts of stuffing box including all the threading. Also clean the top flange in guide bush (7) area and gasket (16) area. Smear all parts with Molykote HSC or Molybedenum Disulfied grease. In some special cases this grease cannot be used due to chemical reaction or with inflammable fluid.

Clean gasket seating area in body. Use a new gasket (16). Apply Mo-S2 grease to gasket also. Carefully place the plug spindle assembly on seat (4). Place the top flange on the valve body. Smear bolt threads with Mo-S2 grease and tighten the nuts equally and evently.

Insert bottom ring (11) in stuffing box bore. Push packing ring around the valve spindle. Take care that the oblique cuts on ring are staggered. Finally, assemble the gland follower (10) and screw gland nut (9). Slightly tighten gland nut (9). Mount actuator and tighten the slotted nut (13). Connect valve spindle with the actuator spindle using lift indicator and start the process. (Refer to 2,3).

4.3 Replacement of Seat

The seat is replaceable as it is screwed in the body. Acutator, top flange, plug, spindle assembly should be dismantled according to 4.2 above.

Seat can be unscrewed by a special tool. Smear the thread of new seat with Mo-S2 greas (with the exception of some special fluids.) Screw in new seat with the help of special tool.Reassemble as per 4.2 above.

For screwing and unscrewing of the seat, specially in case of larger valve size it is recommended to use pneumatic tools.

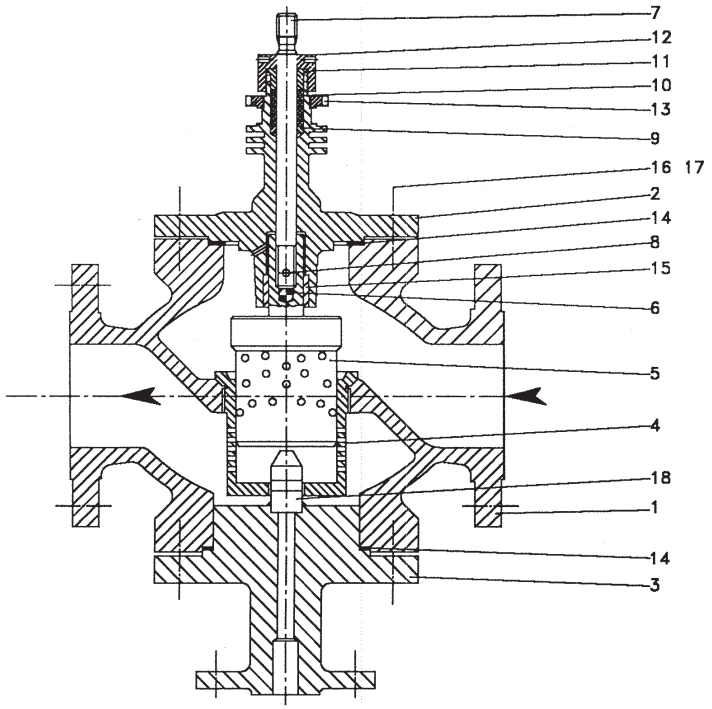
4.4 Replacement of Plug

Dismantle actuator top flange and plug spindle assembly as described in 4.2. It is recommended to replace complete plug spindle assembly instead of plug assembly. Assembly of new plug spindle can be done as described above.

4.5 Recommended Spares

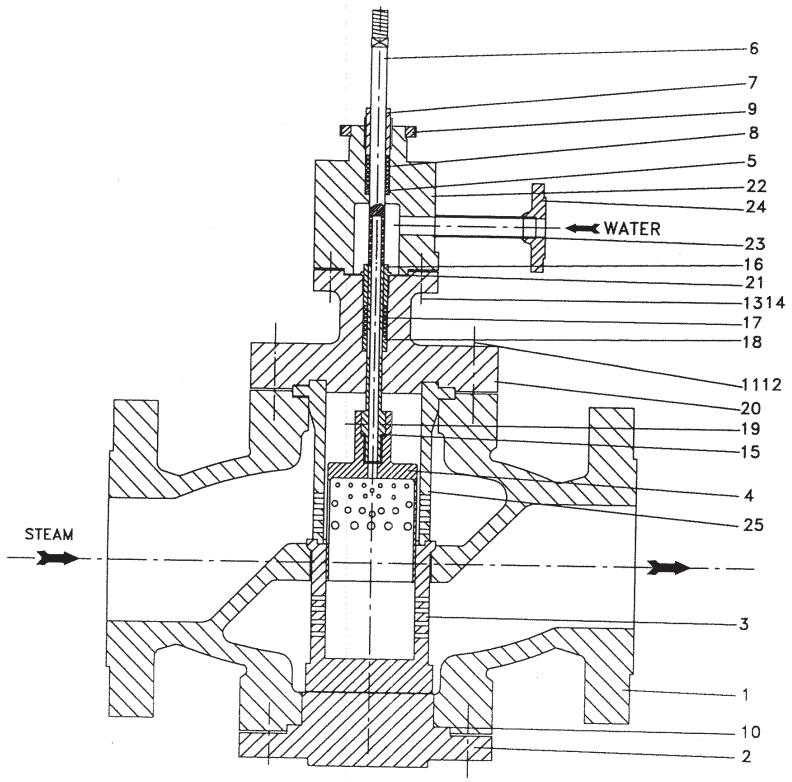
It is recommended to keep following spare parts in stock.

1. Seat and plug spindle assembly. (Part No. 4,5 and 8)
2. Set of gaskets. (Part No. 16)
3. Set of Gland packing ring (Part No. 12)



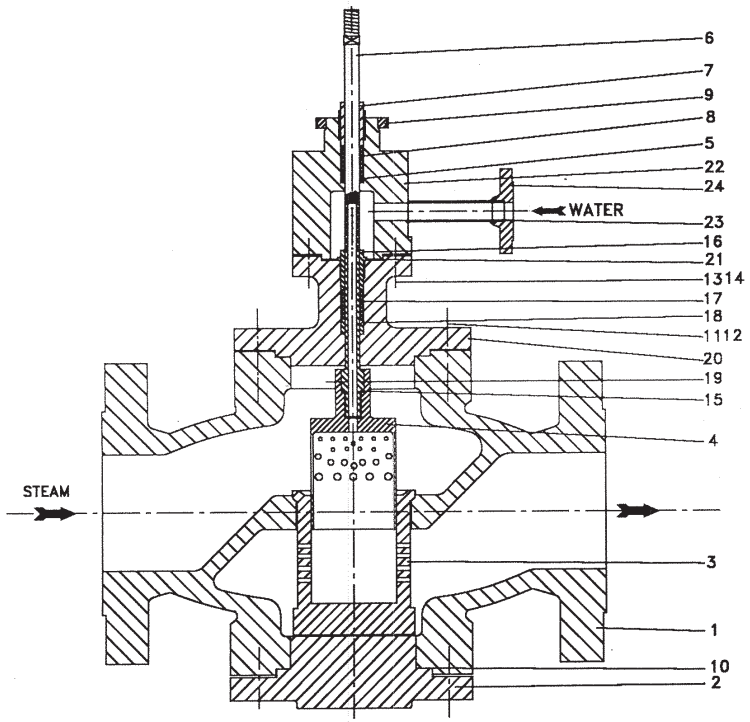
BOTTOM ENTRY PRDS VALVE L2 TRIM DESIGN

I.NO.	PART NAME		
1	VALVE BODY	10	GLAND PACKING RINGS
2	EXT. TOP FLANGE	11	GLAND FOLLOWER
3	BOTTOM FLANGE	12	GLAND NUT
4	SEAT	13	SLOTTED NUT
5	PLUG	14	GASKET
6	BALL	15	GUIDE BUSH
7	SPINDLE	16	NUT
8	SPRING DOWELL PIN	17	STUD
9	BOTTOM RING	18	NOZZLE



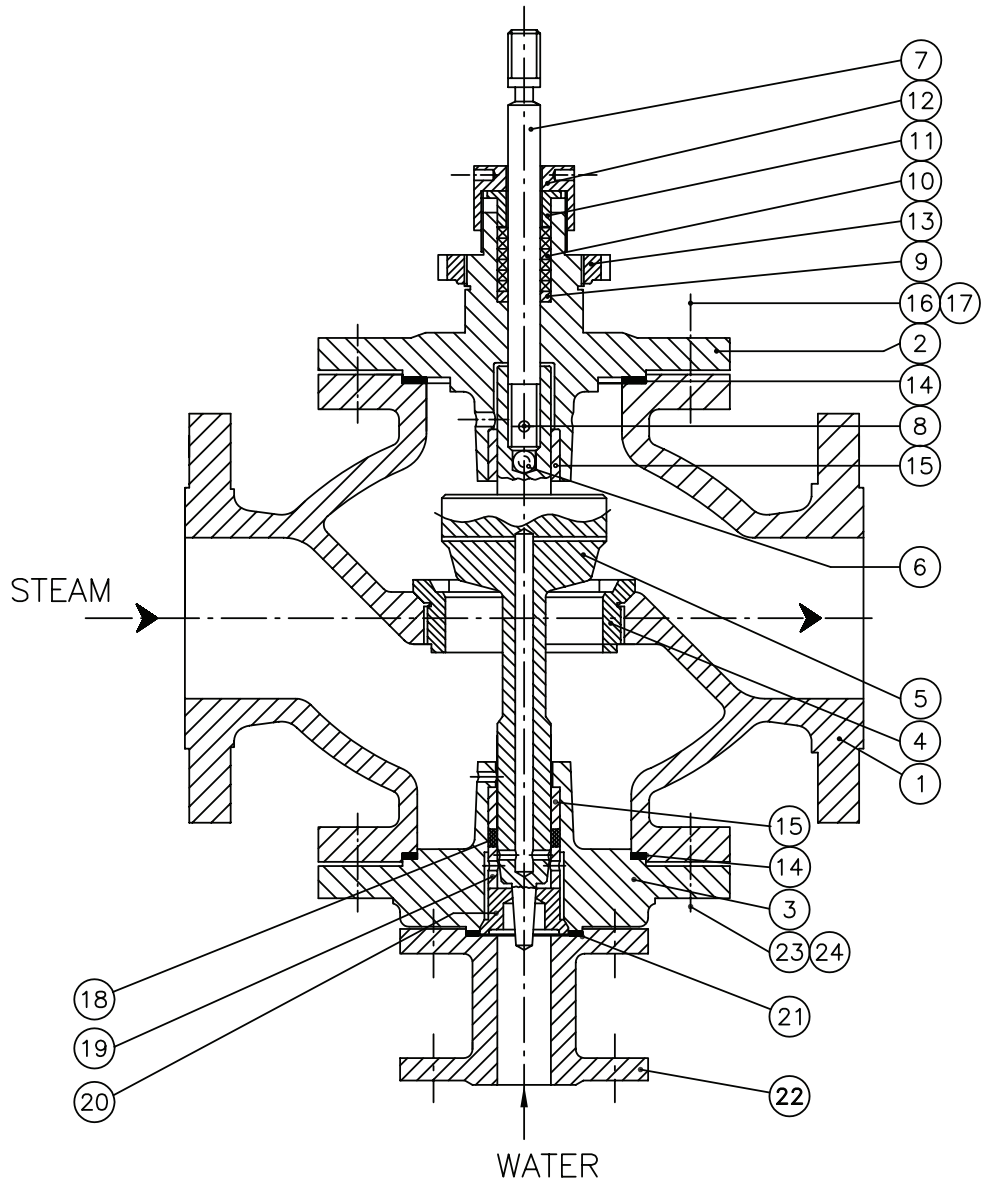
TOP ENTRY PRDS VALVE L3 TRIM DESIGN

I.NO.	PART NAME
1	VALVE BODY
2	BOTTOM FLANGE
3	SEAT
4	PLUG
5	GUIDE BUSH
6	SPINDLE
7	GLAND NUT
8	PACKING SET
9	SLOTTED NUT
10	GASKET
11	BOLT
12	NUT
13	NUT
14	STUD
15	GASKET
16	COOLING WATER SEAT
17	PACKING SET
18	GUIDE BUSH
19	LOCK SCREW
20	INTERMEDIATE FLANGE
21	GASKET
22	WATER CHAMBER
23	PIPE
24	FLANGE S/W
25	SLEEVE



TOP ENTRY PRDS VALVE L2 TRIM DESIGN

I.NO.	PART NAME		
1	VALVE BODY	13	NUT
2	BOTTOM FLANGE	14	STUD
3	SEAT	15	GASKET
4	PLUG	16	COOLING WATER SEAT
5	GUIDE BUSH	17	PACKING SET
6	SPINDLE	18	GUIDE BUSH
7	GLAND NUT	19	LOCK SCREW
8	PACKING SET	20	INTERMEDIATE FLANGE
9	SLOTTED NUT	21	GASKET
10	GASKET	22	WATER CHAMBER
11	BOLT	23	PIPE
12	NUT	24	FLANGE S/W



24	NUTS
23	BOLTS
22	COOLING WATER FLANGE
21	GASKET
20	COOLING WATER FLANGE
19	SLEEVE
18	GLAND PACKING RINGS
17	NUTS
16	BOLTS
15	GUIDE BUSH
14	GASKET (TOP & BOTTOM)
13	SLOTTED NUT
12	GLAND NUT
11	GLAND FOLLOWER
10	GLAND PACKING RINGS
9	BOTTOM RING
8	SPRING DOWEL PIN
7	SPINDLE
6	BALL
5	PLUG
4	SEAT
3	BOTTOM FLANGE
2	TOP FLANGE(STD.)
1	VALVE BODY

SECTION - II

1.0 Arca Universal Diaphragm Actuator

1.1 Drawing of the Product

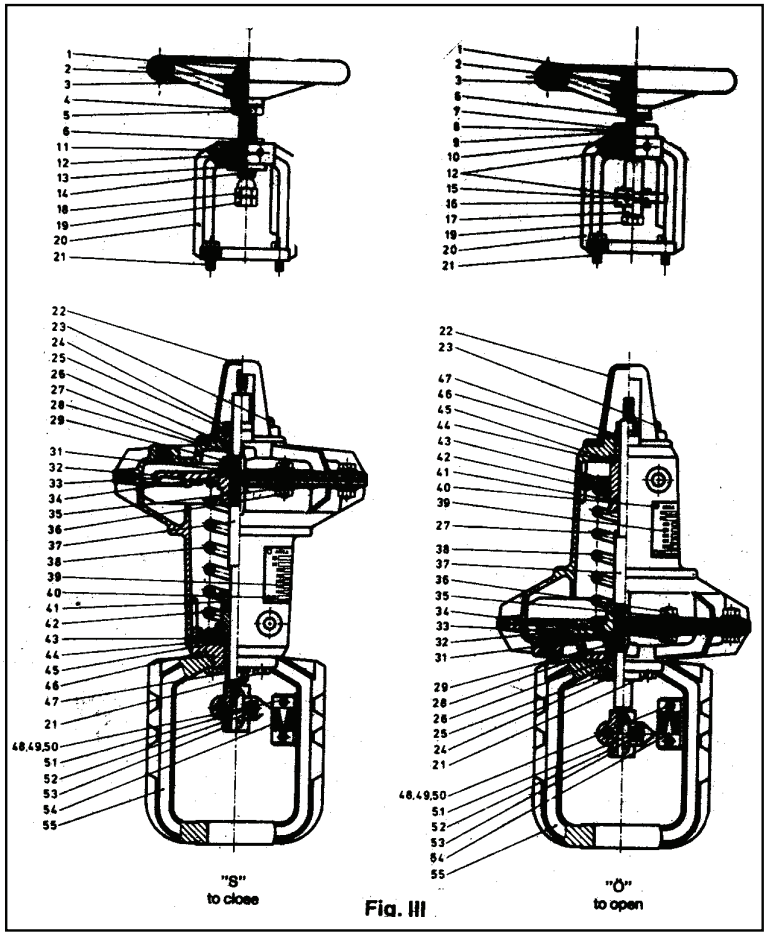


Fig. III

Item No.	Part Name	Item No.	Part Name	Item No.	Part Name
1.	Split pin	21.	Hex bolt	40.	Rivet
2.	Castle nut	22.	Cap	41.	O-ring
3.	Handwheel	23.	Socket screw	42.	Adjustment bolt
4.	Spring dowel pin	24.	Bush	43.	Spring plate
5.	Lock ring	25.	Slide bearing	44.	Supporting disc
8.	Supporting disc.	26.	O-ring	45.	Teflon disc
9.	Teflon disc.	27.	Spacer	46.	Spring housing
10.	Bush	28.	Diaphragm Cover	47.	Slide bearing
11.	Handwheel spindle	29.	Lock nut	48.	Screw
12.	Grub screw	31.	Washer	49.	Star Washer
13.	Threaded bush	32.	Diaphragm	50.	Hex nut
14.	Spring dowel pin	33.	Diaphragm plate	51.	Socket screw
15.	Dowel pin	34.	Hex nut	52.	Hex nut
16.	Clamp ring	35.	Washer	53.	Lift Indicator
17.	Handwheel support	36.	Hex nut	54.	Lift plate
18.	Dome nut	37.	Spindle	55.	Support
19.	Lock nut	38.	Spring		
20.	Handwheel support	39.	Name plate		

1.2 Principle of Operation (Refer Fig. III)

The unversal diaphragm actuators are operated by compressed air. The air is admitted in the diaphragm cover (28) which deflects a diaphragm (32) which in turn moves the actuator spindle (37) which compresses the spring between diaphragm plate (38) and spring plate (33). By removing air from diaphragm cover, the spring expands which results in movement of the spindle in the opposite direction. Thus the actuator spindle actuated one way by air and the other way by spring.

2.0 Getting Started

2.1 General Instructions

1) The name plate (39) on the actuator contains the data concerning the valve and the actuator.
2) When ordering spare parts always state App. No. marked on the name plate.
3) On reversing the actuator or changing the operating conditions check data on the name plate, if necessary order new name plate with corrected data.
4) After replacing spare parts make sure that the joint between diaphragm cover (28) and spring housing (46) and the O-ring (26) are tight. Also check that lift and initial spring tension are correctly adjusted.
5) Diaphragm (32) can with stand temperature from - 30 Deg C to + 100 Deg C. To increase life of diaphragm in case of high temperature, we recommend to provide a heat protection and in case of temperature below 10 Deg C to provided dry air.
6) The mounting position of actuator is vertical on top of the valve. For other mounting position please consult us.
7) The diaphragm cover (28) has a connection of 1/4" NPT for actuator sizes UO/UI and 1/2" NPT for sizes UIII/UV. The air tubing which supplies air to the actuator must have minimum 6 mm inner diameter (8mm OD x 1 mm thick).

2.2 Installation

The actuator offers easy mounting of positioner, roboter, limit switch and air filter Regulator. The spring housing (46) has two tappings of M8 in front and at the back. The support (55) is constructed according to NAMUR principle and provided two tappings of M8 for mounting accessories.

The handwheel arrangement is a seperate sub assembly which can be mounted at any time. On air failure remove the handwheel lock (6) from the lower hole of the handwheel (11/17) and put it into the hole at the upper end of the handwheel spindle.

In case of Air-to-close arrangement (valve opened on air failure) to close the valve turn handwheel (1) clockwise.

In case of Air to open arrangement (valve closed on air failure) to open valve turn handwheel (1) anti-clockwise.

ATTENTION : Before changing to automatic service with air, turn handwheel (1) to uppermost position and replace handwheel lock to lower hole of spindle.

2.3 Commissioning of the Product

The initial tension of spring (38) can be adjusted so that different operating conditions in the valve can be adapted to the available spring ranges.

The air pressure given to the actuator must be sufficient to start the spindle movement. If the required pressure for starting the spindle movement is above or below the desired starting signal (e.g. 0.2 bar), it can be corrected by turning the adjustment bolt (42) until the starting signal and start of spindle movement correspond. The spring tension (i.e. starting air signal) can be increased by turning adjustment bolt (42) anticlockwise.

3.0 Reversibility of the Actuator

The actuator is constructed in such a way that it can be reversed at any time without additional parts and thus the valve can be changed from an air to open into a air to close and vice versa. This can be achieved as follows :

3.1 Unscrew 2 No. screws (23) and remove cap (22)

3.2 Uncrew 4 nos. bolts (21)

3.3 The diaphragm cover (28) and spring housing (46) bolted together can be mounted in reverse sense (i.e. upside down) on the support (55).

3.4 Tighten 4 no. bolts (21) and also assemble cap (22) by tightening 2 nos. screws (23).

if the diaphragm cover (28), is above the increasing signal pressure effects a downward movement of the actuator spindle (37).

If the diaphragm cover (28) is below the increasing signal pressure effects an upward movement of the actuator spindle (37).

The handwheel arrangement is designed for one action only. For reversing the handwheel arrangement with “Diaphragm cover below” part no. 7,8,9,10,11,15 and 17 are required. However for handwheel arrangement with “Diaphragm cover on top”. Part No. 4,5,11,13,14 and 18 are required.

4.0 Trouble Shooting

The actuator has enormous spring force, especially in case of reinforced springs. It is not possible to release the spring totally by adjustment bolt (42) in every case. Therefore, use the mounting aid !

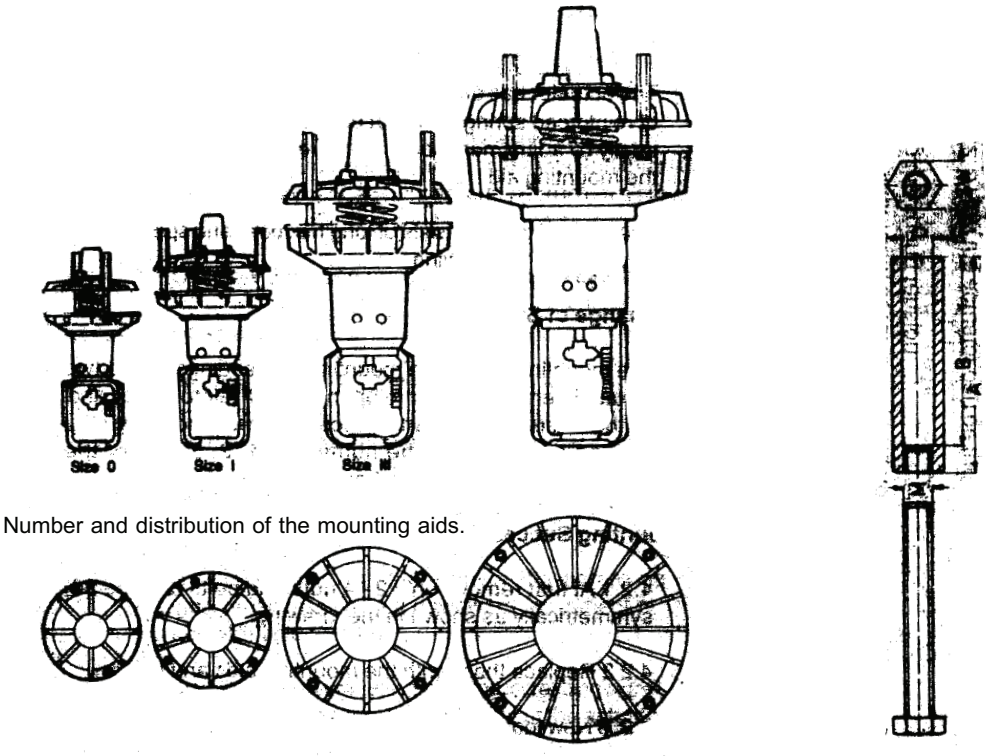
The mounting aid consists of long hex bolts and special nuts as shown in the drawing.

4.1 Exchange of Spares

The mounting shows the mounting proceedings for the two actuator versions ‘O’ (air to open) and ‘S’ (air to close) and for the different spare parts. Proceed with the mounting step by step according to the numerical 1, 2, 3, etc. of the mounting plan. (refer Mounting plan)

4.2 Mounting Succession (Refer Fig. IV)

1) At first remove only 2-4 nuts and bolts (34 and 36) symmetrically as shown in the drawing.
2) Replace these with the mounting aids and tighten.
3) Now loosen and remove all nuts and bolts (34 and 36)
4) Loosen the mounting aids slowly and evently, so that the diaphragm cover and spring housing seperate, releasing the spring tension.
5) Now the actuator can be further dismantled and spare parts can be replaced as per mounting plan. The reassembly follows in reverse succession.



Number and distribution of the mounting aids.

FIG. IV

Screw designation	A	B	D	SW	M	L	
M8 x 75 DIN 933-8.8 in mm	75	65	9	13	M8	75	UI
M10 x 150 DIN 933-8.8 in mm	145	133	11	17	M10	150	UIII and UV

MOUNTING PLAN

	Reversing	Spare part exchange with					
		Air to Close			Air to Open		
		Diaphragm (32)	Bearings and O - Ring	Spring (38)	Diaphragm (32)	Bearing and O-ring (25,26)	Spring (38)
Loosen Cyl. screws (23) and remove cap (22) resp. hand adjustment.	1		1				
Release spring (38) by turning adjustment bolt (42) counter clockwise untill bolt turns easily and spring plate (43) rests on spring housing (46)	2	1	2	1	1	1	1
Loosen clamp screws (52) at lift indicator (53) and remove divided lift indicator from spindle (37)	3			2	2	2	
Remove hex. bolt (21) in lower part of support.					3		
Remove bolts (34,36) at diaphragm cover. If diaphragm sticks, seperate by screw driver at peripheral slit. If spring tension is still high, first fasten the mounting aids. See paragraph 8 and instructions for using the mounting aid.		2	3	3	4	3	2
Remove spacer (27) from spindle (37) and unscrew lock nut (29)		3			5		
Exchnage diaphragm (32) with a new one. Fibre - reinforced side towards diaphragm plate.		4		6			
Remove diaphragm cover (28) with support (55) from spindle.						4	
Exchange O-ring and / or slide bearing (25,26)			4			5	
Take diaphragm plate (33) complete with spindle (37) and diaphragm (32) out of housing (46)				4			
Take off spring housing (46) and spring plate (43)							3
Exchange spring (38) with a new one.				5			4
Turn actuator upside down and place it on suport	4						
Further mounting in reverse succession Refer para 2.1.4 and 2.3	3 to 1	3 to 1	3 to 1	4 to 1	5 to 1	4 to 1	3 to 1

4.3 Recommended Spares

The actuator is almost service free and the diaphragm has a long service life. We recommended to keep following spare parts in stock.

Item No.	Description
32	Diaphragam
25	Slide bearing
26	'O' Ring
38	Spring

Field Service Report

This form should be used to report field problems. A copy should be filled out by our Forbes Marshal customer service engineer. Any servicing which requires the product to be sent back to Works cannot be completed without this report. If the product is returned to our Works, you should include either the original excise gate pass or our invoice number and date.

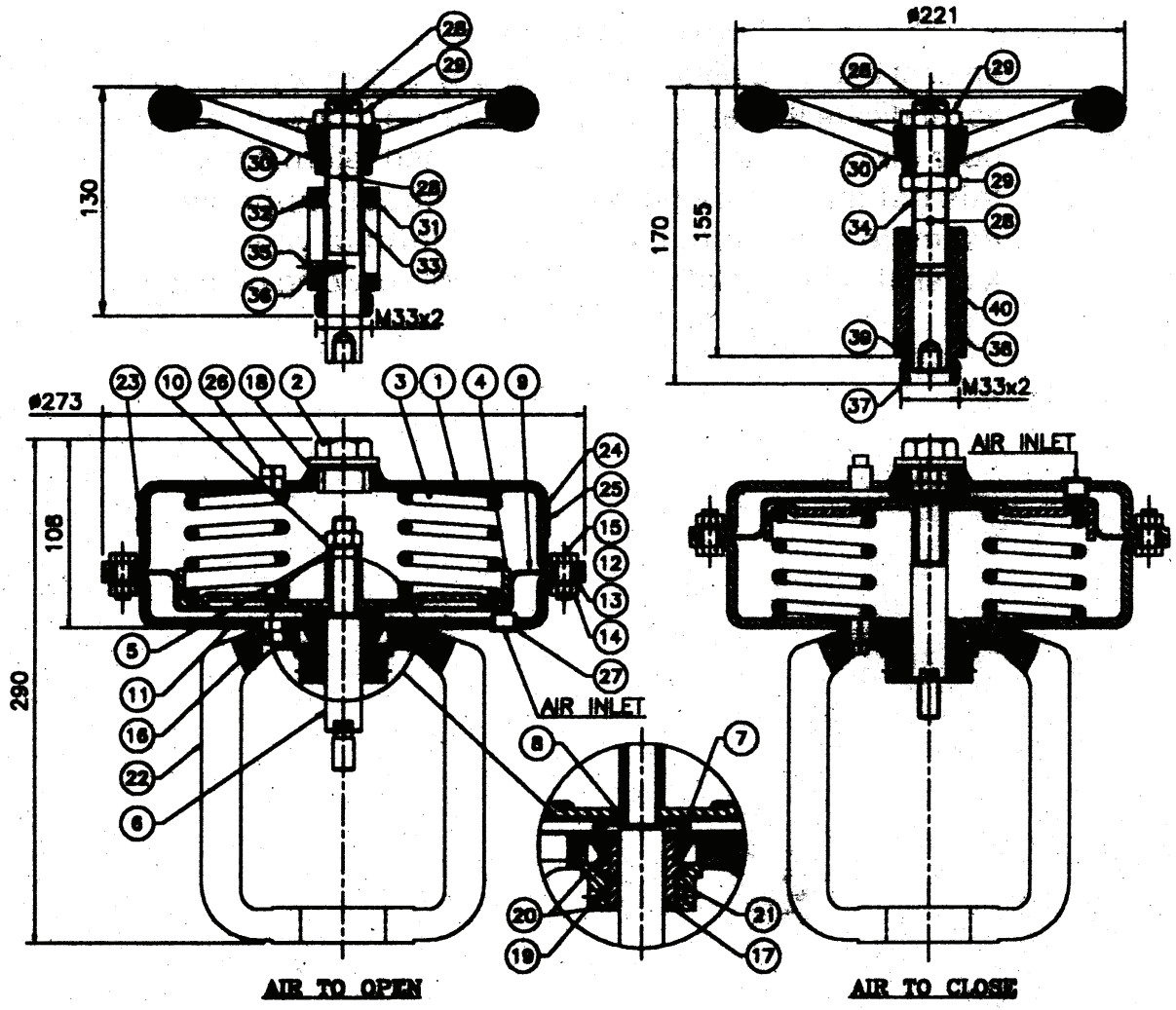
If you'd prefer an estimate before proceeding with repair :

Your should clarify on the form whether you would like to see an cost estimate before we make any necessary repairs. If you indicate that an estimate is required, our Works Engineer will complete Part 6 of the form and return it to you. If this estimate is stisfactory, you should approve the estimate and return the approved form to your Forbes Marshal representative. Only then will servicing proceed.

5.0 Multi Spring Actuator

5.1 Drawing of the Product

CROSS SECTIONAL DRAWING WITH DIMENSIONS



PART LIST OF MSA ACTUATOR					
ITEM NO.	DESCRIPTION	QTY.	ITEM NO.	DESCRIPTION	QTY.
1.	Cover-Actuator	1	21.	Nut-Spindle	1
2.	Nut Cover	1	22	Support - Actuator	1
*3.	Spring	3-12	23	Plate Product. CV	1
4.	Plate - Diaphragm	1	24.	Plate Attention	1
5.	Guide - Diaphragm Plate	1	25.	Rivets (Aluminium)	4
6.	Spindle	1	26.	Plug Vent	1
7.	Support - Diaphragm Plate	1	*27.	Cap Plastic	1
*8.	'O' Ring	1	28.	Lock - Pin Handwheel	2
*9.	Diaphragm	1	29.	Nut	2
10.	Lock Nut-Spindle	1	30.	Handwheel	1
11.	Housing - Actuator	1	*31.	Disc Teflon	1
12.	Bolt Cover - Short	8	32.	Disc Supporting	2
13.	Washer Spring	10	33.	Spindle - Handwheel (A.O.)	1
14.	Nut	10	34.	Spindle - Hand Wheel (A.C.)	1
15.	Bolt Cover - Long	2	*35.	Grub Screw (A.O.)	1
16.	Plug	1	36.	Support - Handwheel (A.O.)	1
17.	Boss Base	1	37.	Support - Handwheel (A.C.)	1
*18.	'O' Ring	1	*38.	Bearing Slide	1
*19.	Bearing Slide	1	*39.	O - Ring	1
*20.	'O Ring	2	40.	Spacer - Handwheel	1

* Recommended Spares

5.2 Principle of Operation

(refer above figure)

The Multi-Spring Actuators (MSA) are operated by compressed air. The air is admitted in the actuator housing (11), which deflects the diaphragm (9), which in turn moves the actuator spindle (6) which compresses the springs between the diaphragm plate (4) and actuator plate (1). By removing air from diaphragm cover, the springs expand which results in the movement of the spindle in opposite direction. Thus the actuator spindle actuated one way by air and other way by springs.

6.0 Getting Started

6.1 General Instructions

The nameplate on the actuator contains the data concerning the valve and actuator, When ordering spare parts always mention the application number marked on the nameplate. On reversing the actuator or changing the operating conditions check the data on the nameplate, if necessary order new nameplate with corrected data.

After replacing the spare parts make sure that all the joints especially between the actuator cover (1) and the actuator housing (11) and O-ring (18) are tight. Also check that lift and initial spring tension are correcty adjusted.

Diaphragm (9) can withstand temperature from - 22^0 F to + 212^0 F. To increase life of diaphragm in case of high temperature, we recommend you to provide heat protection and in case of temprature below 14^0 F to provide dry air.

The mounting position of actuator is vertical on top of the valve. For other mounting position please consult us.

The diaphragm cover (1) has a connection of 1/4" NPT for actuator size MSA - 1 and of 1/2" NPT for sizes MSA-II/III. The air tubing, which supplies air to the actuator must have minimum 0.24" inner diameter. (0.31" OD x 0.04" thick.)

6.2 Installation

The actuator offers easy mounting of positioner, Pneumatic Controller, Air Filter Regulator and Limit Switch. The spring housing (11) has two tapings of (M8) in front. The support (22) is constructed according to NAMUR principle and provides two tapings of M8 of Mounting accessories.

The hand-wheel arrangement is a separate subassembly, which can be mounted at any time. In case of air to close arrangement (valve opened on air failure) to open the valve turn the hand-wheel (30) clockwise. In case of air to open arrangement (valve closed on air failure) to open turn the hand-wheel anti clockwise.

Attention : Before switching to automatic service with air, turn hand-wheel (30) to uppermost position.

7.0 Assembly Instructions For MSA Actuators

7.1 * Actuator Assembly

1) Ensure all parts are deburred, clean and lubricated.
2) Assemble diaphragm plate (7), diaphragm (9), diaphragm plate and guide assembly, sequentially, on the spindle (6). Ensure that O-ring (8) is in position. Tighten lock nut (10) on to the spindle.
3) Assemble the boss base (17), to diaphragm housing (11) ensure o-ring (18) & (20) and slide bearing (19) in the place.
4) Lubricate spindle assembly ; insert it from top in the diaphragm housing assembly till the end. Align assembly bolt holes of the diaphragm with that of diaphragm housing.
5) Place selected type and quantity of springs (3) on the diaphragm plate (7) duly guided of the bottom as per drawing.
6) Position sprig cover (1) on diaphragm housing, align assembly bolt holes.
7) Insert two long assembly bolts M8 x 30 diametrically opposite and tighten nuts by one turn alternatively till all the bolts of standard M8 x 25 size can be inserted properly and can be engaged by nuts. Replace two numbers M8 long bolts by standard M8 x 25 bolts. Tighten all bolts partially till fully tightened up to torque level of 8.85 lbf.in.

8) Establish pneumatic connection at (11) the base of actuator housing. Pressurize assembly and check for ease of spindle movement, lift (should be at least 0.08” more than specified) and leakage from joints (raise supply pressure to 72.52 psi)

9) Assemble nut cover along and cap plastic at respective places.

7.2 * Actuator and Support Assembly :

1) Place the actuator on the top of actuator support, locate plug in the hole provided on top face of the support. Tighten nut-spindle on boss base ensuring its location in the step provided in the support. This ensures alignment of valve and actuator spindle.

2) Tighten nut-spindle fully using C-spanner.

7.3 * FM Valve and Actuator Assembly

1) For Air to open operation, ensure that the valve spindle is completely down and plug is sitting tight on the seat.

2) Place actuator- support on the valve top flange taking guidance of the step on valve top flange. This ensures alignment of valve and actuator spindle.

3) Clamp two halves of the lift indicator, carefully aligning the split threads of the indicator with that the spindle.

8.0 Reversibility of MSA Actuator

The actuator is designed in such a way that it can be reversed at any time without additional parts and thus valve can be changed from Air to open to air to close and reverse. This can be done in following sequence :

a. Remove nut cover (2) / hand-wheel assembly from actuator cover (1).

b. Remove lock nut (10) from top of spindle (6).

c. Remove spindle off the actuator assembly from bottom side.

d. Remove boss base from actuator housing.

e. Insert spindle from top of the actuator aligning in the guide diaphragm plate (5). Tighten lock nut on the spindle.

f. Assemble boss base, along with o-rings and slide bearing on actuator cover.

9.0 Trouble Shooting

1. How to reverse actuator with or without hand-wheel ?

1.1 Open the valve till it is 10% opening giving signal of around 6 mA or mannually using hand-wheel.

1.2 Unscrew the coupling. Disassemble the lift indicator and remove the hand-wheel assembly by unscrewing the grub screw (35), hand-wheel support (36) and hand-wheel assembly (30) in anti-clockwise direction.

1.3 Remove all the tubing. Remove positioner and accessories if any.

1.4 Unscrew the spindle nut (21) ; remove any two opposite nut bolts of the actuator and insert two no. Long bolts (M8) size. This is for avoiding accident that might happen due to initial compression of springs.

1.5 Unscrew all the remaining nut-bolts diagonally.

1.6 Remove the cover (1), springs (3).

1.7 Pull out the diaphragm plate assembly with the spindle (6).

1.8 Hold the spindle in vice in the slots at its bottom. Unscrew lock nut (10), remove diaphragm plate (4), diaphragm (9), o-ring (8), ‘Diaphragm plate support’ (7).

1.9 Assemble all above parts from diaphragm plate support (7), as shown in the 'air to close diagram.

** It is essential to order boss base (17), with two o-rings (20) and slide bearing (19) and air to close hand wheel assembly as shown or if the actuator is without hand-wheel then nut cover (2), to be ordered.

1.10 Assemble the diaphragm plate assembly into the cover (1) as shown in figure air to close.

1.11 Tighten the spindle nut (21).

1.12 Do all the tubing to the actuator housing (11) in the vent provide (27).

** a) There are certain changes to be made in Positioner / Pneumatic Controller as the case may be. These are explained in the respective manuals.

2. How to check diaphragm failure and air leakage ?

2.1 Give 87 Psig air supply at air inlet (27).

2.2 Put soap solution near 'boss base assembly' (17). All the joints, spindle and cover interface and diaphragm clutching (periphery) and check for bubble. No leakage is allowed. in case of leakage tighten the joints or change the o-rings with respect to the area of leakage.

3. How to change the increase / dicrease force capability ?

3.1 Force capabilities can be changed, by increasing number or type of springs. This is for MSA-I actuator. In case of U-series, turn the adjustment bolt clock-wise till the desired lift position of valve spindle is achived at higher air pressure. In case further force capabilities are required, change the spring type to re-enforce from standard and if already re-enforced is used then go for higher sized actuator.

4. How to adjust (using coupling) the valve lift with the actuator lift ?

4.1 Change the position of end of valve spindle in the coupling and adjust its distance with the actuator spindle such that the valve completes its travel.

5. How to check the spring range ?

5.1 Give air pressure to the actuator slowly.

5.2 Note the pressure reading when the actuator spindle starts moving. Suppose the spring range is 3-15 Psig. The actuator spindle starts moving at 3 Psig and attends maximum lift at 15 Psig. If any deviation in this is not found then couple the actuator spindle with the valve spindle at the required lift.

6. How to mount various accessories on the actuator ?

6.1 Mounting the Positioner :

Mount the positioner on the support on inlet side of the valve at opposite side of air inlet of the actuator. Fit the Positioner link on lift indicator. Fit the Positioner mounting bracket to the Positioner. Fit the threaded pin in to stroke scanning lever depending upon valve size. Fit the positioner support / yoke.

6.2 Mounting Position Transmitter :

Fit the positioner link on the opposite side of Positioner. Mount the bracket to Position Transmitter. Fit the stroke scanning lever to shaft, which is extruding out of the Transmitter. Fit the thread pin to stroke scanning lever depending upon size of valve. Mount the Position Transmitter, on support on opposite to Positioner on the other leg of support.

6.3 AFR / ALR / Booster Relay / I to P / Solenoid Valve :

Mount the bracket on actuator by loosening any of the actuator cover bolt nearest to the positioner and accessories to be connected to it to save tubing length. Fit the AFR / ALR on the bracket.

6.4 Limit Switches :

Mount the limit switches on its bracket using screws / nuts. Mount the bracket on the hand-wheel support using M8x20 mm size bolt. After mounting proper tubing as per plan is to be made. Ensure Zero Leakage.

Due to our continuous Product Development, the above data is subject to change without notice. For the latest information please contact your nearest sales representative.

10.0 Tightening Torque

THREAD SIZE	TORQUE lbf-in
M8	88.51
M10	141.61
M12	265.52
M16	619.55
M20	885.1

11.0 Spring Location (on the spring plate over the boss) :

*Initially take any boss as no. 1 and count from that.

NUMBERS OF SPRINGS	LOCATION
2	1,4
3	1,3,5
4	2,3,5,6
6	1 TO 6
>6	1 to 6 and in above sequence

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Field Service Report			
Report # :	Date		
Division			
1) Customer Information			
Customer Name :			
Address :			
Site :			
Contact person :		Phone :	
Reference :			
2) Product Information			
Product Description :			
Serial Number :	Original Invoice # :	Date	
Input / Inlet Details :			
Output / Outlet Details :			
The Product is	Online	Offline	
Connections	Flanged	Screwed	Welded
Mounting Details :			
3) Application Information			
Process Media :			
Pressure :	Temperature :		
Sensor Details :			
Mounting Details :			
4) Observed Problems or Symptoms			
5) Proposed Action			
Repair at Site	Return to Works	Estimate First or Under Warranty	
Field Engineer's Sig.		Customer's Signature :	
6) To be Filed in for Estimate Purposes			
Estimated cost :			
List any imported spares which must be provided by Customer			
Signature of MFG / CSD Engineer.			
7) Customer's Endorsement			
We accept the above repair estimate. Signature & Stamp.			

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Operation and Installation Manual

ECOTROL VALVE

Energy Conservation | Environment | Process Efficiency

www.forbesmarshall.com

OPERATING AND MAINTENANCE INSTRUCTIONS

Single seated ECOTROL valve

8C series (1/2" - 4" , ANSI 150 & 300), 6N series (6" - 16" , ANSI 150 & 300)
6H series (1" - 10" , ANSI 600, 900 & 1500)

Thanks for choosing our product incase if you experience any dificulty with the installation or operation of this equ please contact our customer service representative.

Manufactured and Marketed by
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A Forbes Marshall Company

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13.1 Screw connections, general 10

1 Description of the function

Valves of this type are normally applied as control valves according to DIN 19226.

They reduce the pressure of a mass-flow by means of the valve plug.

The valve is featured by :

- A parabolic plug, which, in combination with the seat,
- is of single-stage execution
- The flow characteristics are determined by the shape of the valve plug.
- Metallic seal between valve plug and seat
  - At the stroke position 0% the plug is pressed with its tapered edge against the edge of the seat closes the valve.
- Quick change seat.
  - Both sides can be used by simply turning the seat around.
- Spring-loaded, V-shaped, stuffing box packing rings (Graphite for High temp.)
  - maintenance-free

2 Warning symbols

Safety informations and warnings are intended to avert danger from the life and health of users and mainter personnel and to prevent material damage. They are highlighted in this manual by the headings defined h They are also marked by warning symbols next to where they appear. The heading used have the follo meaning for the purpose of this manual and the product lables.

Danger

indicates that death, severe personal injury of substantial property damage will result if proper precautions are not taken.

Warning

indicates that death, severe personal injury or substantial property damage will result if proper precautions are not taken.

Caution

indicates that minor personal injury or property damage can result if proper precautions are n taken.

Note

indicates an important information about the product itself or the respective part of the instructio manual which is essential to highlight.

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3 Safety Instructions

Warning

The valve is to be used exclusively for the application according to our order confirmation. Any o application is considered as not conforming and the user if fully responsible for any damage t may result from this.

Unathorized modifications or the use of spare parts other than original Forbes Marshall Arca par exclude our liability for damages that may result from this. In this case, the user is bearing th responsibility.

Maintenance and repair of the actuator must be carried out only by qualified personnel, it is important to follow the corresponding rules and regulations for pressure vessels and stea boilers.

The actuators produce high positioning forces. Mounting and starting up must be carried out und careful consideration of the safety instructions.

Special reference is made to strictly follow the rules and regulations for plants with explosio hazards.

Before starting any maintenance works, it is important to ensure and well note the following :

- Drainage of the pipeline
- Get complete information on the possible dangers, which can occur through remainders o the flow medium and take suitable measures (safety gloves, safety glasses. etc.)
- Let the valve cool down, if required.
- Make sure that no third person can put the plant into operation.
- Remove any pressure, which might build up in a shut-off pipeline.

3.1 Qualified Personnel

Warning

in the sense of the operating instructions are persons who are familiar with the mounting, starting up, and operation of this product and who have the corresponding qualification for such works, e.g.

- Education or training according to the actual safety standards for maintenance and use of adequate safety equipment.
- First aid training
- For plants with explosion hazards : Special training or instructions, or the authrorisation respectively to carry out works in plants with explosive hazards.

4 Mounting site

- The valve should be accessible, at least from one side.
  If mounted in an elevated level,, a service gangway, or similar should be provided.
- For valve size DN 80 or larger, and electric crane or a tackle should be available.

5 Mounting

The valve is provided with flange connections and will be screwed into the pipeline after removing protective from the inlet and outlet sealing surfaces (flanges) by using the gaskets provided at site.

The following should be noted :

Caution

- Mounting position : Pipe line horizontal, spindle verticle;

For other mounting positions special provision must be made to support the weight of th actuator.

- The Valve must not be exposed to stress-loads of the pipeline.
- On the upstream - and downstream sides of the valve, the pipe should have a straight le of at least 10 x nominal diameter. Other armatures or branches are not allowed.
- A bypass-line with shut-off valves on the upstream - and downstream sides of the valve recommended.

6 Actuator Mounting

Actuator of diffrent types can be simply and easily mounted on each valve. This is achieved thro the selection of standard parts for mounting and coupling purposes.

- If an electric actuator is used then the following information should be noted.

Caution

- When the valve moves to its closed position, the supply to the motor is disconnected torque limit switch.
- When the valve moves to its open position, the supply to the motor is disconnected travel limit switch.

7 Before first starting-up

Pickling and rinsing

The following procedures are recommended :

(1) The trim is removed from the valve body before the pickling and rinsing process.

- Dismantle the trim completely so that only the valve body will remain in the pipeline.
- Install rinsing kit in place of the valve seat (to be ordered separately)
- Mount rinsing flange(s) (to be ordered separately)
- Pickling and rinsing
- Clean valve body, remove rinsing kit
- Replace gaskets
- Remount trim in the valve body

(2) In place of the valve a spacer is fitted.

- Remove valve from pipeline (in case of flanged valves)
- Mount spacer into the pipeline
- Pickling and rinsing
- Remove spacer from pipeline
- Replace gaskets and packings
- Remount valve into the pipeline

8 Starting up

Warning **Follow instructions under section** "Safety Instructions" **on page 4.**

Caution

- Avoid thermal shocks.
  - Bring valve slowly to operating temperature

  From temperature differences of approximately 300 K the temperature change velocity of max. 2 K/min has to be kept.
- Check tightness of the flange connections
- Setting of gaskets : see also under DIN 2505 / 4.5
  - Tighten screw connections crosswise **Table(s) of torque moments** (see page 10)

9 Maintenance

9.1 Servicing

Warning

- Clean spindle (50) regularly
  - **Move actuator in its upper end position and secure it.**
  - Clean spindle (50) with a soft cloth, **never use grinding paper.**

9.2 Maintenance

The valve is mainly maintenance - free

After a longer period of operation or under very changing operating conditions, the valve should serviced according to section **Starting up** on page 6

9.3 Stuffing box sealing

The stuffing box sealing is maintenance - free.

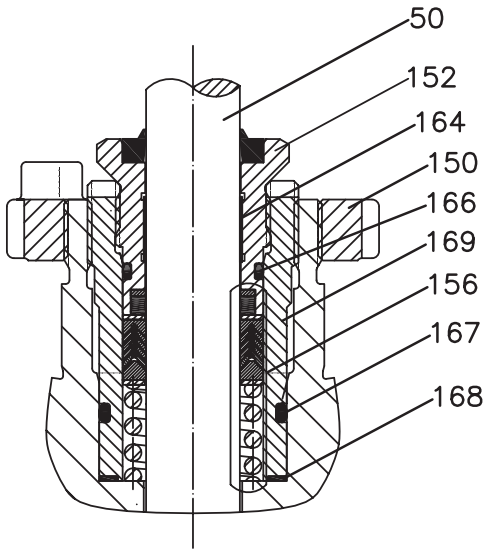

Fig. 1a - Stuffing box with PTFE packing

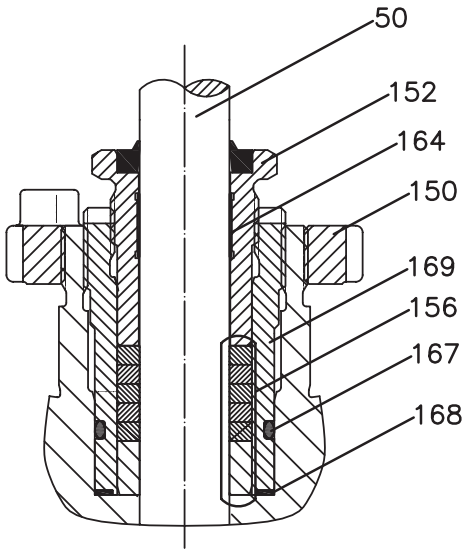

Fig. 1b - Stuffing

Detail X

10 Dismantling and remounting the valve

Warning **Follow instructions under section** "Safety Instructions" **on page 4.**

10.1 How to proceed

- Dismantling the valve
  - Dismantled parts have to be secured thoroughly against falling down (risk of injury or damag
- Cleaning of all components.
- Remounting in the reverse order
  - by using the new parts.
  - Replacement of gasket and packings.
  - insert - if provided - dynamically loaded O-rings and form-rings with O-ring grease, unless proce conditions do not allow its use.
  - dynamically loaded gaskets of pure graphite - if provided - are greased with a thin laye "Joudol Grease" (product of Messr. Burgmann) unless process conditions do not allow its use
  - Pay attention to torque moments for screw connections. See under section **Table(s) of torque moments** on page **10**
  - After mounting, the plug is to be moved into its upper and lower end positions by means actuator or manually. It must be made sure during this procedure that the plug should n jerk nor scrape. If required, loosen the flange connections, centre the flange position a retighten the flange screws.
  - When ordering spare parts, please copy and complete form at the end of the operating instruct and send or fax it to the a.m. address.

10.2 Actuator

Warning

- **Move actuator in a medium position and secure it.**
- Disconnect actuator and take it off
  - Follow mounting instructions of the manufacturer of the actuator.

10.3 Top flange

- Unscrew stuffing box Gland Nut (152)
  - See also under **Fig. 1** on page 6
- Loosen screw-connection between body (1) and top flange (2).

Caution

- Take-off top flange (2).
  - The plug (26) is eventually taken off together with the top flange (2). Pull plug (26) out of the top flange (2)
  - **Attention ! Do not bend the spindle (50)**

10.4 Stuffing box packing

- Remove packing set (156), consisting of V-rings, supporting rings, and spring
  - See also under **Fig. 1a** on page 6

  OR

  Remove Packing set (156) Consorting Graphite rings, carbon ring
  - See also under **Fig. 1b** on page 6

10.5 Slide bearing

Note

- Take the slide bearing (164) from the stuffing box Gland Nut (152)

At the mounting of the slide bearing (164) you have to consider :
- turn the coated side towards the spindle (50)
- turn the tissue side towards the stuffing box Gland Nut (152)

10.6 Valve plug

Depending on the valve type, the plug (26) has already been dismantled. Otherwise

- Pull plug (26) with spindle (50) out of the body (1).

10.7 Spindle

- The Spindle (50) can be exchanged as a unit together with the plug (26) see fig. 2a or Otherwi
- The spindle (50) is interchangeable then see fig. 2b
- Beat out the border of hex. nut (57)
- Unscrew and replace hex. nut (57)
- Pull spindle (50) out of the plug (26)

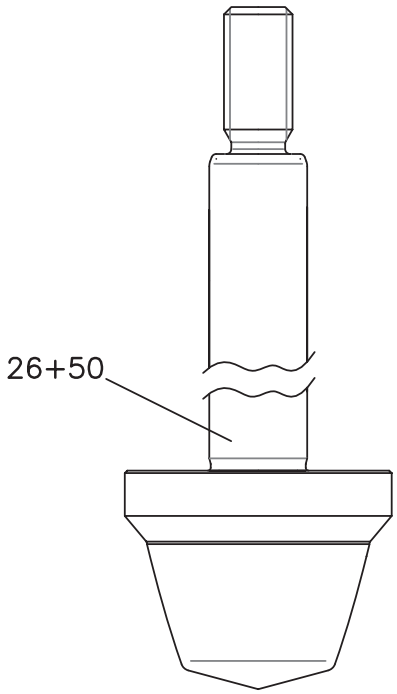

Fig 2a Plug and spindle as a Unit together

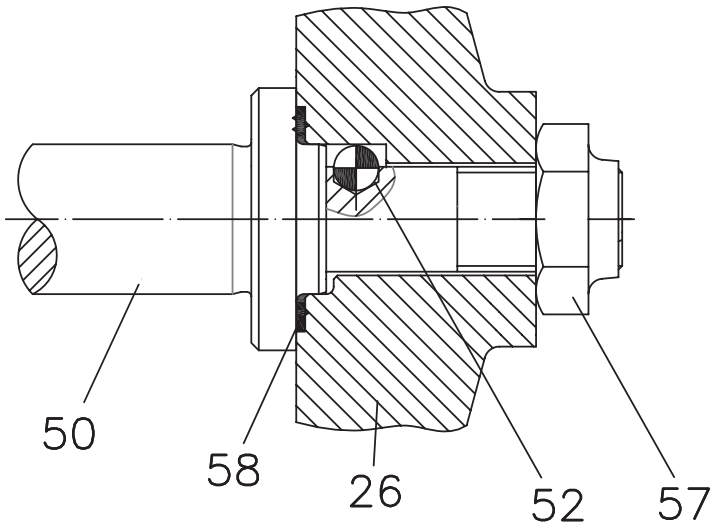

Fig 2b- Plug and Spindle Interchangeable
(Picture shows example with parabolic plug)

10.8 Spacer & seat

- Take spacer (182) and seat (20) out of the valve body (1).
  - Both sides of the seat (20) can be used.
- Replace sealing element (180)

11 Sectional Drawing

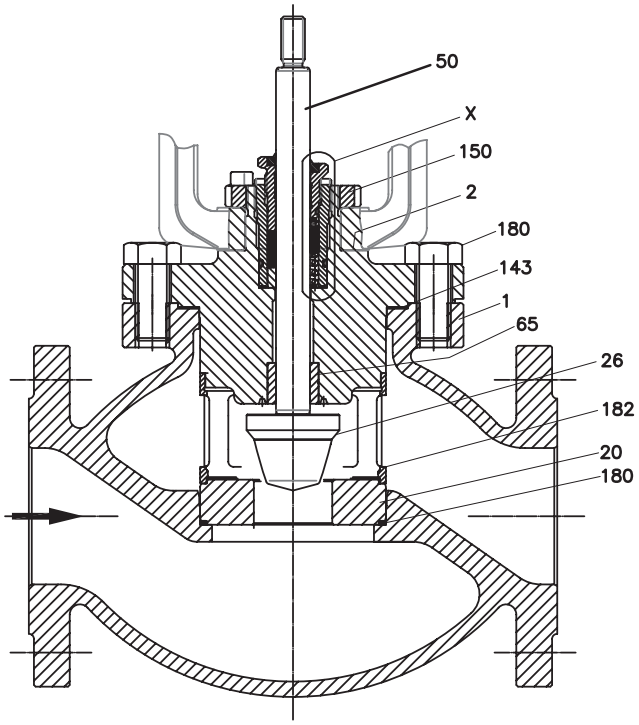

Fig 3a Std. Top Parabolic Plug

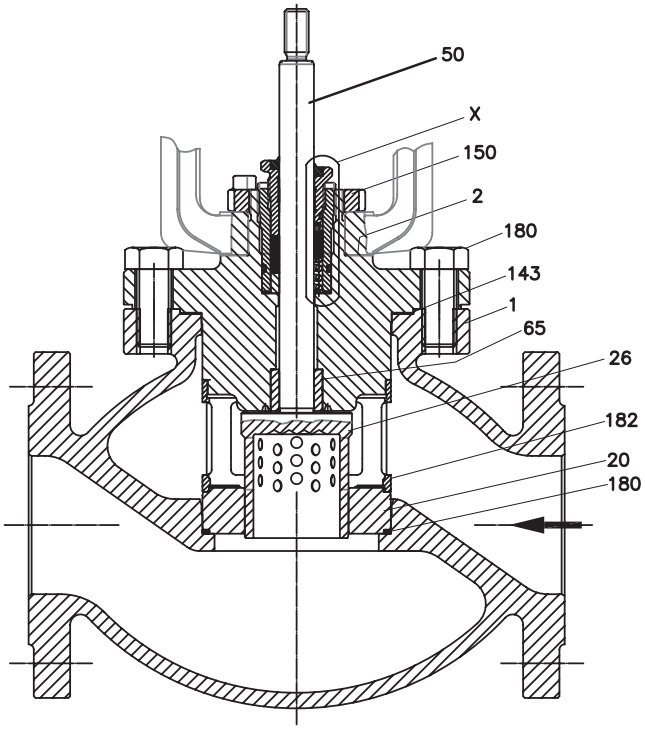

Fig 3b std. Top Perforated Plug

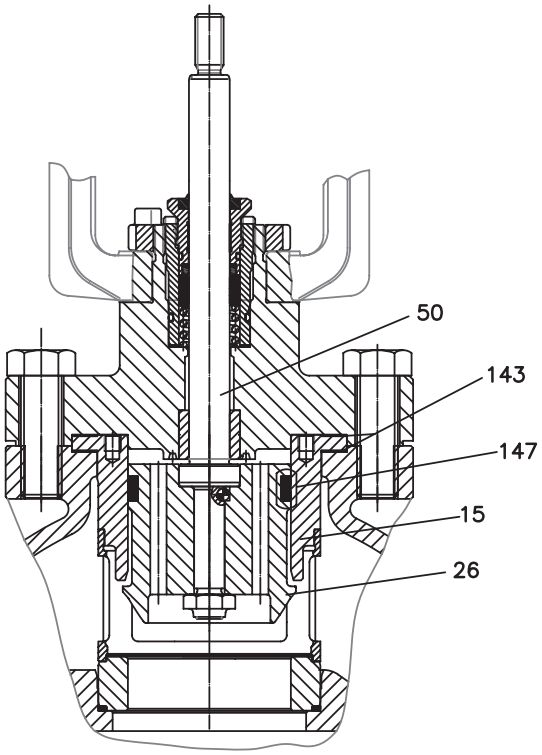

Fig 3c Std top with Pressure Balance Plug.

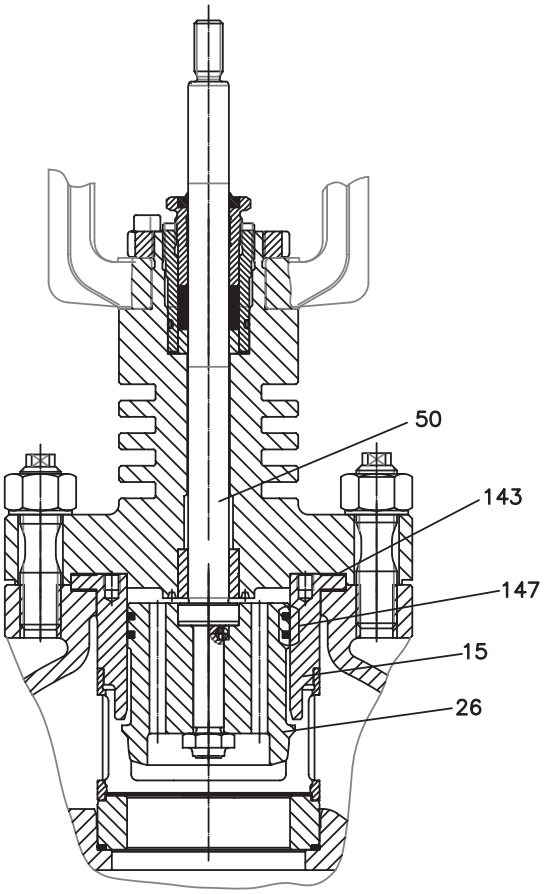

Fig 3d Extended top with Pressure Balance Plug.

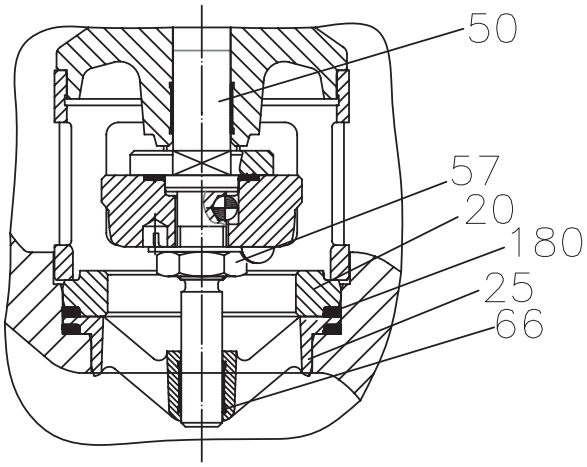

Fig 3e Double guided Parabolic Plug

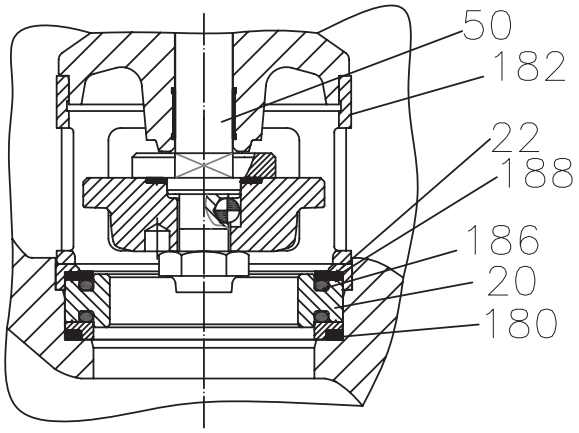

Fig 3f Soft Seated Plug

12 Part List

Recommended spare parts are marked with an asterisk (*)

Item No.		Part Name
1		Valve body
2		Top flange
15		Sleeve
20	*	Seat
22		Clamping ring
25		Double guiding sleeve
26	*	Valve plug (complete)
50	*	Spindle
52	*	Steel ball
57	*	Hex. nut
58	*	Gasket
65		Guide bushing
66		Double guiding bush
80	*	Screw bolt
143	*	Gasket
147	*	Pressure balance seal rings (set)
150		Slotted nut
152		Stuffing box screw
156	*	Packing set
164	*	Slide bearing
166	*	O-ring
167	*	O-ring
168	*	Gasket
169		Sleeve
180	*	Sealing element
182		Spacer
186	*	Soft seal o-ring
188	*	Soft sealing element

13 Table(s) of torque moments

13.1 Screw Connections, General

Thread Size	Torque Moment [Nm]
M10	24
M14	65
M16	100
M20	200
M22	280
M24	350
M27	500
M30	600
M33	800
M36	1000

13.2 Screw Tighten and Loosening sequence

All screw should be Tighten with a Thumb rule of “Equal and opposite”

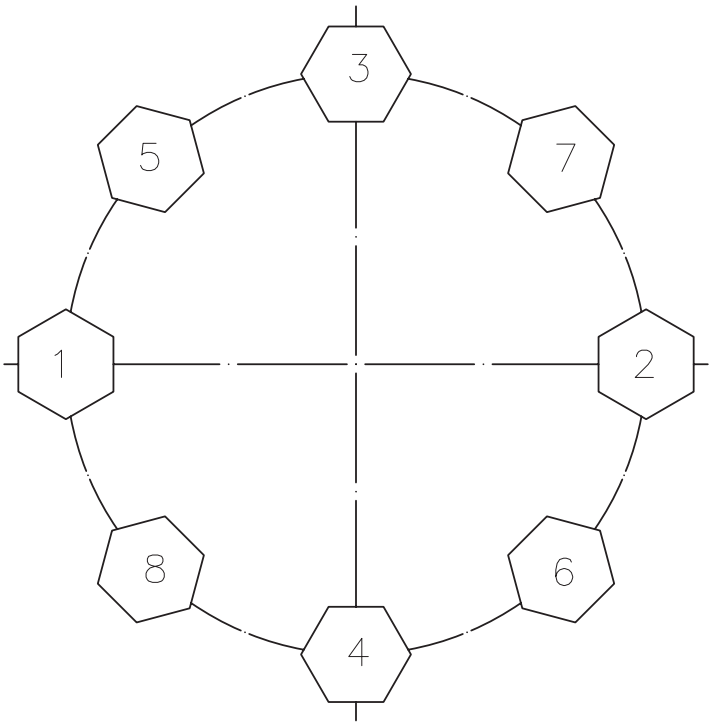

Fig. 4a- e.g. 8 Screw Tighten and Loosening sequence

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Field Service Report			
Report # :	Date		
Division			
1) Customer Information			
Customer Name :			
Address :			
Site :			
Contact person :		Phone :	
Reference :			
2) Product Information			
Product Description :			
Serial Number :	Original Invoice # :	Date	
Input / Inlet Details :			
Output / Outlet Details :			
The Product is	◆ Online	◆ Offline	
Connections	◆ Flanged	◆ Screwed	◆ Welded
Mounting Details :			
3) Application Information			
Process Media :			
Pressure :	Temperature :		
Sensor Details :			
Mounting Details :			
4) Observed Problems or Symptoms			
5) Proposed Action			
Repair at Site	◆ Return to Works	◆ Estimate First or Under Warranty	
Field Engineer's Sig.		Customer's Signature :	
6) To be Filed in for Estimate Purposes			
Estimated cost :			
List any imported spares which must be provided by Customer			
Signature of MFG / CSD Engineer.			
7) Customer's Endorsement			
We accept the above repair estimate. Signature & Stamp.			

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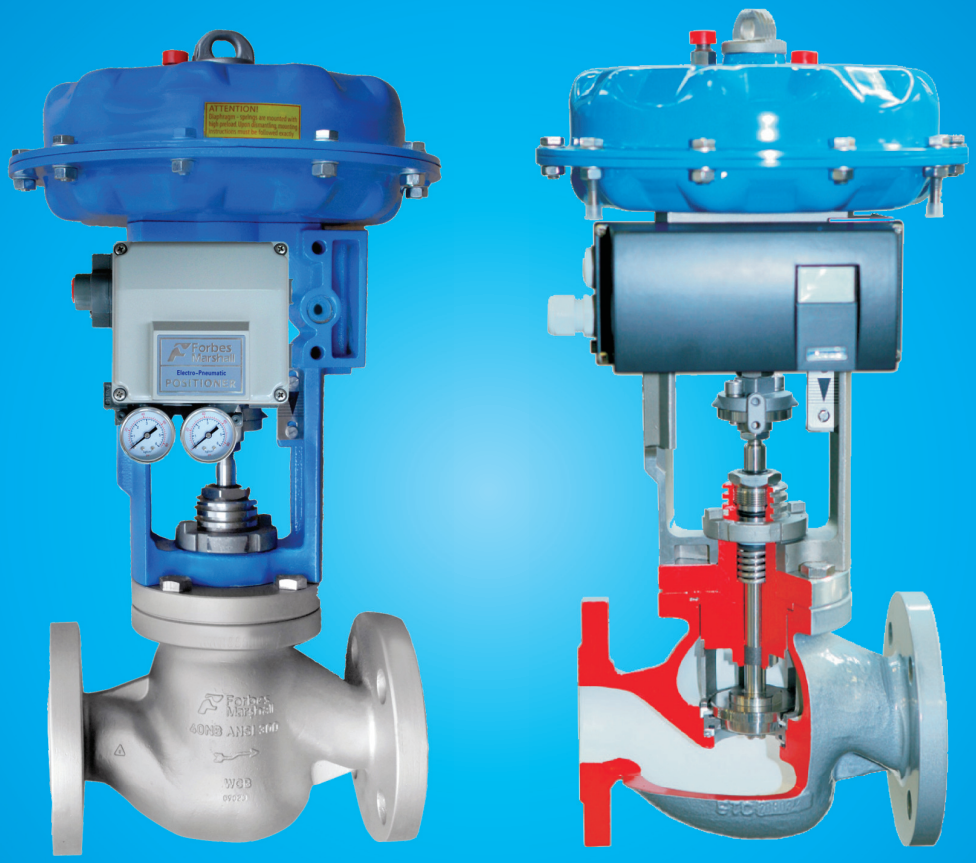

Operation and Installation Manual

FMAPL-812 SERIES (MF) ACTUATOR

Energy Conservation | Environment | Process Efficiency

www.forbesmarshall.com

OPERATING AND MAINTENANCE INSTRUCTIONS

Multi-spring Actuator

812 Series

Thanks for choosing our product incase if you experience any dificulty with the installation or operation of this equ please contact our customer service representative.

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ARCA REGLER

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1 Description of the function

The actuator series 812 is designed as a single-acting multi spring diaphragm actuator for valves with a stroke. The central spindle (1) of the actuator is connected to the spindle of the valve by means of a coup actuator spindle is precisely guided in a slide bearing (5), and the operating air chamber is sealed with a gasket with wiper ring (3) Connected to the spindle (1) is a diaphragm plate (10), which suports the diap (13) and transmits movements to the spindle (1). The diaphragm (13) seperates the actuator body (9, 15) pressure chamber and spring chamber. The actuator spindle (1) is moved when the force of the operating one side of the diaphragm (13) surpasses the force of the springs (14) on the other side. The spring cha ventilated by means of a splashproof cap (17/98) to avoid positive or negative pressures in the spring chamb

2 Execution

- compact design
- fabric-reinforced diaphragm
- flexible force control
- special splash-proof ventilation
- robust ductile casting yoke according to NAMUR
- the action (air-to-open/air-to-close) can be reversed with additional parts.

3 Warning symbols

Safety informations and warnings are intended to avert danger from the life and health of users and mainter personnel and to prevent material damage. They are highlighted in this manual by the headings defined h They are also marked by warning symbols next to where they appear. The heading used have the follo meaning for the purpose of this manual and the product lables.

Danger

indicates that death, severe personal injury of substantial property damage will result if proper precautions are not taken.

Warning

indicates that death, severe personal injury or substantial property damage will result if proper precautions are not taken.

Caution

indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note

indicates an important information about the product itself or the respective part of the instructio manual which is essential to highlight.

4 Safety Instructions

Warning

Maintenance and repair of the actuator must only be carried out by qualified personnel.
The actuators produce high positioning forces. Mounting and starting up must be carried out under careful consideration of the safety instructions.
Special reference is made to follow the rules and regulations for plants with explosion hazards.
Before starting any maintenance works it must be secured that no third person can put the plant in operation.

4.1 Qualified Personnel

Warning

in the sense of the operating instructions are persons who are familiar with the mounting, starting up, and operation of this product and who have the corresponding qualification for such works, e.g.

- Education or training according to the actual safety standards for maintenance and use of adequate safety equipment.
- First aid training
- For plants with explosion hazards : Special training or instructions, or the authrorization respectively to carry out works in plants with explosive hazards.

5 Mounting site

- The actuator should be easily accessible, at least from one side and from above.
  If mounted in an elevated position, a service gangway or similar should be provided.
- For actuator size MFIII and larger, and electric crane or a hoist should be provided.

6 Mounting

The yoke of the actuator (34) is provided with a single, centred mounting hole which allows a rotation actuator in any direction. The actuator is mounted to the valve by means of the slotted round nut of th Actuator and valve are coupled with the stroke indicator.

Caution

Note :
Mounting position : pipe line horizontal;
actuator position verticle
diaphragm chamber above the valve.

In case of other arrangements please consult us for further information.

- Arrange position of actuator and additional equipment in true alignment with the valve.

7 Adjustment

7.1 Stroke

Caution

The mounting of the stroke indicator for coupling the actuator to the valve is carrcied out accor to the instructions for the stroke indicator.

- When coupling the actuator to the valve, make sure that no traverse rforces are transmitte to the spindle (1).
- Do not distort the spindle (1) radially !
  - The stroke sensor (35) must be arranged in the cross-axis of the yoke (34), as shown sectional drawing.

Note

- When adjusting the stroke make sure that the closing position of the armature is not block by the internal, non-adjustable, stroke limitation of the actuator.

7.2 Signal air connection

The connections (Z.....) of the actuator are threaded G 1/8 B.

7.2.1 Standard

- Close connection "Z$_1$" at the yoke (34) by means of a screw plug.
- Connect supply air pipe to connection "Z$_2$" at the yoke (34) by means of a pipe union.

7.2.2 When using ARCA positioner (integrated mounting)

- Close connection "Z$_2$" at the yoke (34) with plug screw (29).
- Connect positioner according to its operating instructions.

8 Mounting the valve positioner

8.1 Integrated mounting of ARCA valve positioners

Operating air connection and stroke-tapping are realised directly when the positioner is plug-mounted. Further mounting details will be found in the operating instructions of the corresponding instrument.

8.2 Mounting according to IEC 534 (NAMUR)

The yoke (34) of the actuator has been designed according to the standard IEC 534 Part 6 (NAM which allows the mounting of additional instruments by means of the mounting thread M8.
Additional parts are required for the stroke tapping according to NAMUR.

9 Modification / Exchange of spare parts

9.1 How to proceed

Follow instructions under section "Safety Instructions"

- Dismantling in the described order
- Cleaning of all components
- Remounting in the reverse order
  - using the new parts
- Lubricate O-rings with suitable O-ring grease
- The exchange of static gaskets and O-rings is not described.

9.2 Reversing the action from "air to open" to "air to close"

- Dismantle positioner, if provided
- Remove screw plug (39) with ring gasket (38)
- Unscrew hex. nut (18)
- Remove protective spray-water cover (17, 41)
- Screw off thereaded adapter (46)
- Unscrew complete sleeve (4)
- Take off the complete actuator head and turn it upside down
- When remounting, follow instructions under section **Stroke** on page 5

9.2.1 Additional mounting steps

- Install external air pipes (43)

9.3 Guiding and sealing elements

- Dismantle stroke indicator
- Dismantle positioner, if provided
- Unscrew threaded pin (36) and remove stroke sensor (35)
- Unscrew complete sleeve (4)
- When remounting, follow instructions under section **Stroke** on page 5
- Remounting in the reverse order, using the new parts

Caution

- The actuator spindle (1) must be free from edges before the complete bushing (4) is slide
  If required, remove edge with fine grinding paper.
  In case of damages in the range of the sealing element, the spindle must be exchanged.
  The spindle must not be machined in this area.

9.4 *Diaphragm*

Danger

The springs (14) are installed with high tension. If the following instructions are not strictly regarded, grievous injuries, resulting in death, as well as serious material damages cannot be excluded.

- Dismantle positioner, if provided
- **Remove 4 hex. nuts (23) and bolts (21) evenly sepread over the circumference.**

Danger

- **Install long bolts (21) M8 x 80 in grade 8.8 and new hex. nuts (23) in grade**
  - The long bolts (21) and nuts (23) in grade 8.8 are not part of our supply.
- Loosen hex. nuts (23) of the short bolts (21).
- **Loosen hex. nuts (23) of the newly mounted bolts (21) evenly, to release the tension off the springs (14).**
- Take off upper cover (15) of actuator
- Remove pressure springs (14)
- Unscrew hex. nut (18)
- Pull reversing sleev (8) with diaphragm plate (10) off the spindle (1).

Note

- Remove diaphragm (13) and replace by a new diaphragm (13)
  - The texture side of the diaphragm must show to the diaphragm plate (10)

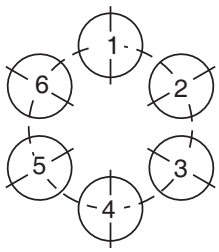
9.5 *Springs*

- Dismantling according to section Diaphragm on page 7 until pressure springs (14) are dismantled.

Caution

- Exchange tension springs (14) against new springs.
  - The springs should always be exchanged as a complete set.
  - Note carefully the arrangement of the springs (14).

Number of springs	Mounting at position
2	1 + 4
3	1 + 3 + 5
4	2 + 3 + 5 + 6
6	1 - 6
9	1 + 3 + 5 + 1 - 6
12	2 x 1 - 6



10 Sectional drawings

10.1 Air to Open

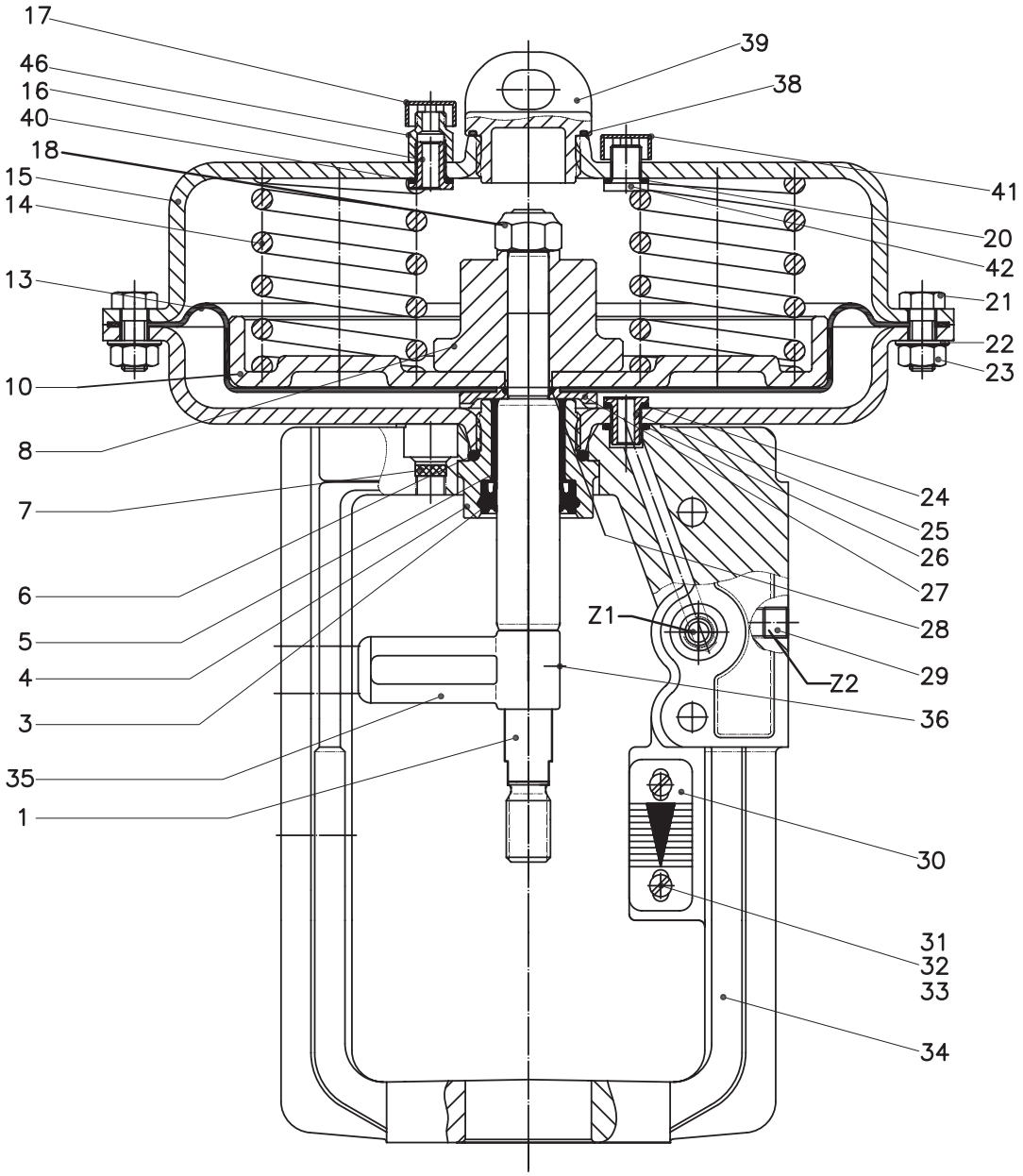


Fig. 1a - AIR TO OPEN

10.2 Air to Close

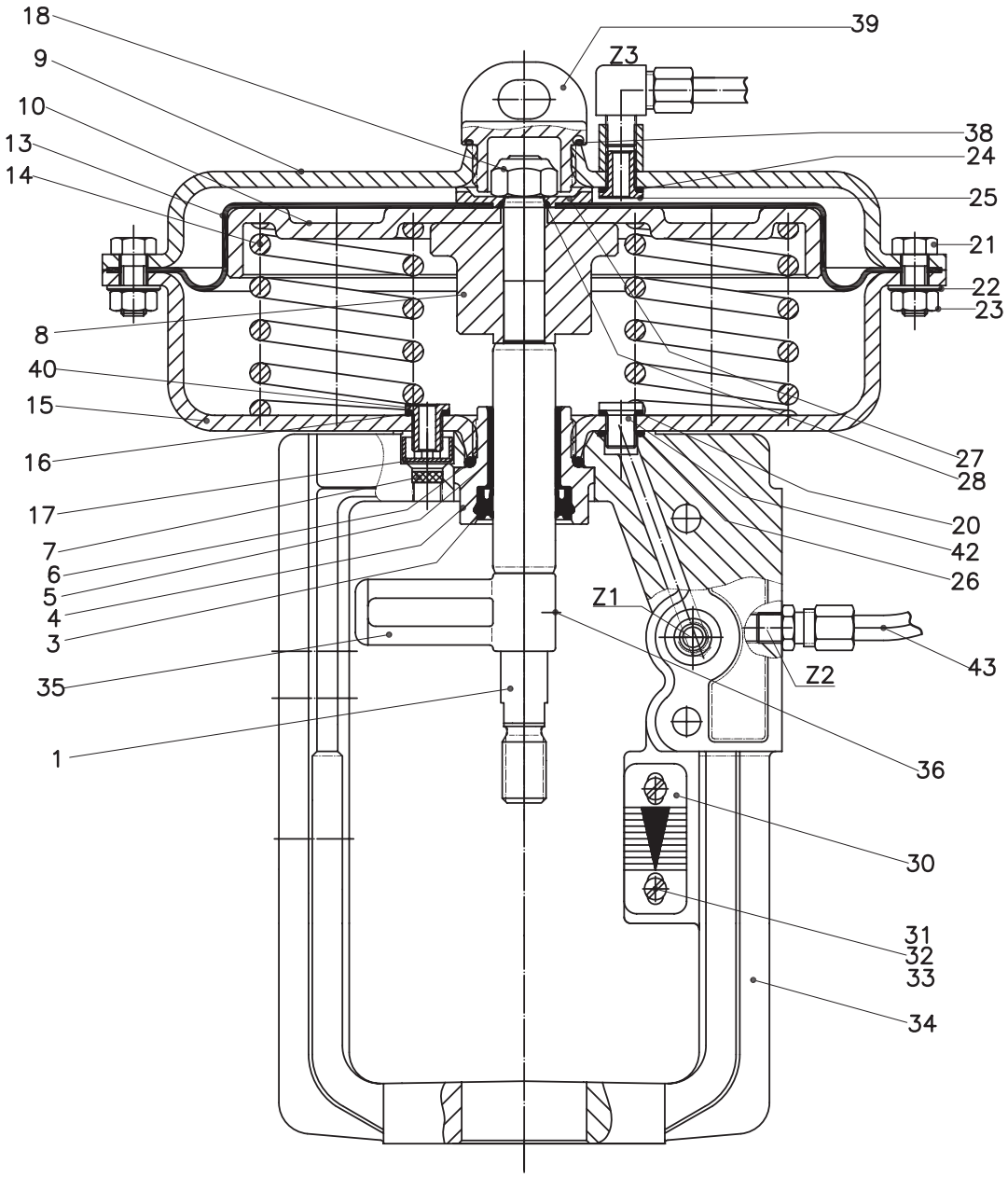


Fig. 1b - AIR TO CLOSE

11 Part List

Recommended spare parts are marked with an asterisk (*)
Spare parts list.

Item No.		Part Name
1		Spindle
3	*	Gasket
4		Bushing
5	*	Slide bearing
6	*	O-ring
7		Filter
8		Reversing sleeve
9		Diaphragm cover
10		Diaphragm plate
13	*	Diaphragm
14	*	Spring
15		Spring cover
16		Gasket
17	*	Protective cap
18	*	Hex. nut
20		Gasket
21		Hex. screw
22		Washer
23		Hex. nut
24		Gasket
25		Threaded sleeve
26	*	O-ring
27		Cup
28	*	O-ring
29		Screw plug
30		Stroke plate
31		Cyl.-screw
32		Lock washer
33		Hex. nut
34		Yoke
35		Stroke sensor
36		Threaded pin
38	*	Gasket
39		Screw plug
40		Threaded sleeve
41		Protective cap
42		Screw plug
43	*	Piping, complete
46		Threaded adapter

12 Table(s) of torque moments

12.1 Screw connections, general

Thread Size	Torque Moment [Nm]
M10	16
M12	30
M16	70
M20	100
M24	180
M27	330

12.2 Screw Tighten and Loosening sequence

All screw should be Tighten with a Thumb rule of “Equal and opposite”

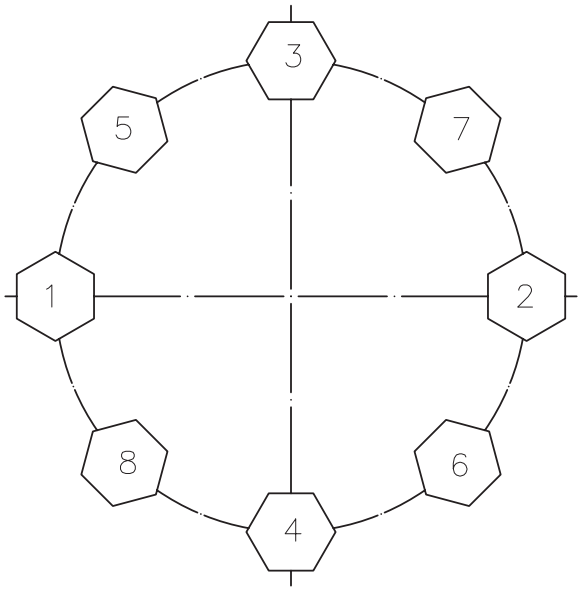


Fig. 2a- e.g. 8 Screw Tighten and Loosening sequence

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ARCA REGLER

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Field Service Report		
Report # :	Date	
Division		
1) Customer Information		
Customer Name :		
Address :		
Site :		
Contact person :		Phone :
Reference :		
2) Product Information		
Product Description :		
Serial Number :	Original Invoice # :	Date
Input / Inlet Details :		
Output / Outlet Details :		
The Product is ◆ Online ◆ Offline		
Connections ◆ Flanged ◆ Screwed ◆ Welded		
Mounting Details :		
3) Application Information		
Process Media :		
Pressure :	Temperature :	
Sensor Details :		
Mounting Details :		
4) Observed Problems or Symptoms		
5) Proposed Action		
Repair at Site ◆ Return to Works ◆ Estimate First or Under Warranty		
Field Engineer's Sig.	Customer's Signature :	
6) To be Filed in for Estimate Purposes		
Estimated cost :		
List any imported spares which must be provided by Customer		
Signature of MFG / CSD Engineer.		
7) Customer's Endorsement		
We accept the above repair estimate. Signature & Stamp.		

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Operation and Installation Manual

SAFETY RELIEF VALVE

Energy Conservation | Environment | Process Efficiency

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Full Lift and Normal Safety Relief Valve

Types **VSE 1 open spring bonnet**
VSR 1 open spring bonnet and adjusting ring
VSE 2 closed spring bonnet
VSR 2 closed spring bonnet and adjusting ring
VSE 4 closed spring bonnet, weight-loaded

Orifice letters SKB (DIN) : A - Z
SKB (API) : EA - TA

Observe design data on the nameplate!

- spring-loaded (cylindrical compression spring)
- weight-loaded
- roller bearing up 8 kN spring force
- cooling spacer for medium temperatures 400 °C

:

.

Attention!
This operating instruction does not specify the extent of delivery. It is valid for several sizes, designs, accessories and additional devices. It contents generally exceeds the contractual determined extent of delivery.

Technical Information and Customer Service:

Forbes Marshall Pvt Limited
A 34-35 MIDC Industrial Estate ,H-Block Pimpri ,Pune -411018
Telephone 0091/20/27442020 Telefax 0091/20/27442040, WWW.FORBESMARSHALL.COM

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1 Danger and Warning Indications

The construction of the FMPL safety valves corresponds to the latest state of engineering and the valid safety regulations.

Nevertheless, improper use or improper installation can cause risks for the personnel or can lead to restrictions in regard of the operational safety. Therefore, the FMPL recommends the operator of the safety valves to take appropriate measures and make sure that the present operating instructions are read and understood by the assigned personnel.

Application Limits

It is only allowed to use the valves according to the details of this operating instructions and according to the parameters and application cases agreed in the delivery contract (see nameplate). The application of the valve has to take place adequate to the medium tolerances of the used materials.

Warnings for the operating and maintenance personnel

Before commissioning and maintenance works familiarise yourself with the legal accident prevention regulations, the local safety instructions and this operating instruction and observe them.
Use the safety valve and its individual parts and accessories only for the purpose intended by us.

Please observe the following points besides the notes given in the text:

- Danger of burning at safety valves and with the connected pipes while operating under increased temperature.
- Disassembly of the safety valve only in case of pressureless plant and after cooling down.
- Protection against risks caused by evaporation also in case of pressureless system; for information please contact the safety inspector concerned.
- After assembly check all sealing points in regard of tightness.
- In case of adjustment make changes at pressure screw and adjusting ring only with clearly reduced pressure to avoid unintended response.
- Carry ear protection during adjustment, if necessary.
- Danger of burning by discharge of small amounts of possibly hot medium in case of safety valves with open spring bonnet (VSE 1, VSR 1).
- Danger of injury while discharging at disconnected discharge line.
- Extreme vibrations can lead to inadmissible increase of operating pressure with the possibly destruction of the safety valve or to the destruction of the balanced bellows with unintentional escape of medium.

Exclusion of Liability

FMPL cannot be held liable in case of improper maintenance and adjustment of a Sempell safety valve, use of inadmissible spare parts or utilities and in case of a temporary or permanent connection of equipment with the safety valve which is not approved by us.

2 Description

Spring-loaded full lift safety relief valves are direct acting safety valves for protection of pressure tanks against inadmissible excess-pressure.

A cylindrical compression spring creates the closing force on the valve disc against the opening pressure of the medium below the valve disc. At normal operating conditions the valve seat is held tight.

By changing the spring compression it is possible to change the set pressure. In case of exceeding set pressure, the pressure of the medium prevails and the safety valve opens.

With full lift characteristic the safety valve opens rapidly at full lift and discharges the total mass flow necessary to prevent a further pressure increase.

With normal characteristic the safety valve reaches the lift necessary for the mass flow to be discharged after response within a pressure increase of maximum 10 %.

After a defined pressure decrease, the safety valve closes again.

By means of the lifting lever at the cap the safety valve can be opened by hand with a set pressure of 85 % at least.

The safety valves are type tested and comply with the requirements of the standards and regulations.

Use within areas exposed to danger of explosion

The safety valves underwent a hazard analysis according to code 94/9/EC with the following result:

- The safety valves do not have a potential ignition source. ATEX 94/9/EC is not applicable to these valves.
- The valves safety may be used in the EX range
- Electrical / pneumatical accessories have to undergo a separate assessment of conformity according to ATEX.
- The surface temperature does not depend from the valve itself but from the operational conditions. Observe while installing.

3 Operation

3.1 Warning Indications for the Operation

Observe safety regulations!

Attention! Unstable behaviour of safety valves such as chattering or vibrating can destroy the valve seat, the safety valve or the pipe and thus causing the failure of the safety function or the shutdown of the plant. Therefore, observe regulations and empirical notes regarding design and dimensioning, fitting and installation.

Attention! Safety valves with weight loading, type VSE 4, are blocked for the transport. Before commissioning remove blocking stem and mount gag plug (17) with gasket (40).

- Design and dimensioning: Do not use larger safety valves than necessary! In case of back pressure use safety valves with bellows.
- Fitting and installation: Lay supply line as short as possible. Use as few bends as possible.
- Keep supply line free from vibrations. Absorb or avoid pressure surges and waves, e. g. caused by pumps or other valves.
- Drain the discharge line and the valve body at their lowest point. Condensate can impair the function of the safety valve.
- Protect lines and valve against freezing.

3.2 Storage Rules

To preclude damages during loading and unloading, move the valve with suitable lifting gears. Handwheels and other driving elements are unsuitable as impact points. The transport shall preferable take place by cable or transport pallet.

SKB-DIN	Max. weight [kg] without accessories about	SKB-API	Max. weight [lbs] without accessories about
A	19	EA	42
B	19	FA	42
C	21		
D	35	GA	77
E	70	HA	155
F - G	80	JA	175
H	90	KA	200
J - K	110	LA	245
L	150	MA-NA	310
M	170		
N	200	PA	440
P	250	QA	555
Q	270		
R	300	RA	665
S	300	TA	665
T	380		
U	410		
V	460		
W	530		
X	1260		
Y	1600		
Z	1870		

At delivery provide the outsides of all ferritic parts of the safety valve except the welding edges with a coat of paint.

The insides of the body are protected by a watery corrosion preservative that has a long-term effect because of the film formative active agents.

All connection inlets are closed by corresponding caps.

In this state the safety valve can be stored in closed, dust-free and dry rooms lying on a pallet without difficulties. Time of storage about six months. A storage of more than six months asks for disassembly and visual check of the inner parts of the safety valve. A weather-protected outside storage is not allowed.

For spare parts out of elastic material (O-rings, scraper rings, rod and piston gaskets) additionally apply:

Temperature: The temperature of the storage shall be between 0 °C and 25 °C since otherwise a hardening of the material and so a shortening of durability will follow. Shield heating elements and lines in heated storeroom so that no direct heat irradiation arises. The distance between the heat source and the stocks has to be 1 m at least.

Moisture: To prevent the formation of condensate, avoid moist storerooms. A relative humidity of below 65 % is at best.

Lighting: The products of elastic materials are to protect from direct sun light and from strong artificial light with a high ultraviolet part. Therefore supply the windows of the storerooms with a red or orange (in no case blue) paint.

Ozone: Protect products of elastic materials from ozone (formation of cracks and embrittlement). The storeroom may not contain ozone generating systems (fluorescing sources of light, mercury vapour lamps, electric motors, etc.).

Oxygen: Protect products out of elastic materials from draught by storage in airtight tanks. Oxygen causes cracking and embrittlement.
If these requirements are guaranteed for products out of elastic materials, the storage time is about 5 years.

For spare parts out of steel:
Store the parts in closed, dust-free and dry rooms so that damages do not occur.

Especially the following protection measures apply:

Disc (3) wax coat of the gasket, net coat
Guide bush (2) protection by net coat

3.3 Installation Instructions

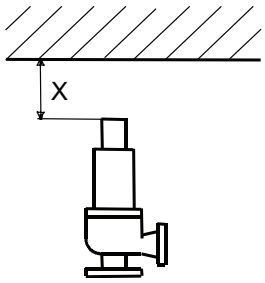
Note: Clean pipes before installing safety valves as otherwise the valve seats can be damaged by foreign bodies when discharging!

Remove transport protection just before installation.

Check plant identification and details on the nameplate.

3.3.1 Installation

The installation zone must be easily accessible for maintenance works. Required free space above the safety valve see section “Dimensions”. In case of large safety valves provide for additional space for lifting gears, at least 500 mm.



SKB	overhead dimension X
A - G EA - JA	300 mm 12 "
H - R KA - RA	700 mm 26 "
S - Z TA	900 mm 36 "

Position of installation vertical, inlet from below. Do not brace valve body when fastening; if necessary compensate bearing of the supporting brackets.

Lay line in such a way that no static or dynamic forces nor forces caused by thermal expansion may be transferred to the valve body.

Please note: Stresses at the valve body may lead to leaking at the valve seat!

3.3.2 Inlet Line

If possible arrange safety valve directly at the nozzle of the tank to be protected. Otherwise lay inlet line between tapping point and safety valve as short and as poor in resistance as possible.

In no case the inlet line diameter must be smaller than the inlet nominal size at the safety valve.

The pressure loss in the inlet line must not exceed 3 % of the set pressure at the greatest possible discharge quantity.

Check inlet line in regard of pressure vibrations according to FBR 153 as far as possible.

Attention! A pressure loss higher than the closing pressure difference may lead to an unstable, uncontrollable behaviour of the safety valve; chattering or vibrating may destroy the valve seat, the safety valve or the line and thus lead to failure of the safety function or to the shutdown of the plant!

For discharge of condensate in case of gases and vapours, the inlet line must have a slope to the tapping point of 15 degrees at least.

Attention! Condensate at the inlet of the safety valve changes the functional behaviour and may lead to an inadmissible pressure increase. Danger of explosion!

In case of liquids with temperatures higher than the ambient temperature, the inlet line must be assembled with slope to the safety valve, or designed as a siphon-type bend in front of the safety valve. Thereby, a heat transmission to the safety valve is avoided which could impair the tightness at the valve seat.

3.3.3 Exhaust Line

In no case the exhaust line diameter must be smaller than the outlet nominal size at the safety valve.

Back pressures in the exhaust line are admissible up to 15 % of the set pressure and for safety valves with compensating piston (SN 144) up to 50 % of the set pressure, in case there are no other restrictions, e. g. with respect to the strength of the body connection flange.

Attention! Higher back pressures may lead to an unstable, uncontrollable behaviour of the safety valve; chattering or vibrating may destroy the valve seat, the safety valve or the line and thus lead to failure of the safety function or to shutdown of the plant!

At the deepest point the exhaust line must be equipped with a drain which is large enough to enable the discharge of minor leaks, e. g. in case of untight valve seat. Particularly in the open air exhaust line, valve body and drain must be protected against icing and freezing, e. g. by (electrical) trace heating; merely insulating is not sufficient!

Do not exchange the drain connection G ¼" at the valve body for the lock screw (44) at orifice letters A40 and B40. Removing the lock screw (44) may change the function of the safety valve!

Attention! An icy, frozen or clogged exhaust line leads to the failure of the safety function! Danger of explosion in case of excess-pressure!

Caution! In case of several safety valves with one common exhaust line, take special safety precautions for disassembling of only one safety valve to exclude danger in case of unintended discharge of other safety valves!

Recommendation! Sound isolate exhaust line and/or provide the same with silencer; in doing so, regard allowable back pressure!

3.3.4 Insulating

In case of hot medium insulate inlet line and valve body. In case of gases and vapours insulate inlet line and valve body very carefully to avoid condensation.

Attention! Condensate at the inlet of the safety valve changes the functional behaviour and may lead to an inadmissible pressure increase; danger of explosion!

The spring bonnet and a possibly mounted cooling spacer shall not be insulated as with heated spring the set pressure decreases.

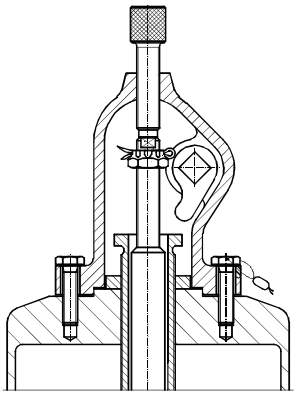
3.4 Pressure Test

The response of the safety valve must be prevented.

Either flange off the safety valve and close the supply line with a blind flange or block the valve. In case of welded-in safety valve a pressure test insert can be used.

Attention! In case of a blocked safety valve the test pressure can amount up to 1.5× of the set pressure without consultation with FMPL.

Turn in the blocking screw instead of the gag plug (17) and tighten it securely by hand so that the disc (4) is blocked in closed position. In case of design with supplementary loading (SN 111) screw off electric solenoid including cooling spacer and replace it against a cap (13) with blocking screw SN 100.



Attention! After the pressure test, restore and check the ready-to-operate state!

3.5 Commissioning

Attention! At safety valves with weight load, type VSE 4, remove blocking screw before commissioning and assemble gag plug (17) with gasket (40).

The safety valve is delivered ready to operate. The set pressure is adjusted at works and secured against unauthorised adjustments by lead seal. Higher medium temperatures can lower the set point at approx. 1 % per 100°C and ask for a readjustment under operating conditions. Standard values see table in section "Adjustment of the Set Pressure".

3.6 Operational Test

Function and reliability of the safety valves are proved by the type test. Therefore operational tests are generally not carried out in the plant. This is only usual for steam boiler safety valves.

3.7 Discharge Test

- Apply ear plugs.
- Slowly increase operating pressure in the plant until the safety valve has fully opened.
- Lower operating pressure until the safety valve closes.

In case of several discharge tests with hot steam allow intermediate cooling down of the safety valve as caused by heating of the spring a slight decrease of the set pressure is possible.

Attention! When discharging, some leaking medium may escape at the open bonnet (8) in case of safety valves type VSE 1 / VSR 1. Danger of scalding by hot steam!

3.8 Adjustment of the Set Pressure

Attention! A change of the lead sealed spring adjustment must only take place in the presence of the competent inspector.

The adjustment of the set pressure takes place on the test stand. If the set pressure is adjusted in the plant, the pneumatic measuring device A 143 should be applied as by means of this device the set pressure can be adjusted without increasing the operating pressure.

Attention! Adjusting only with lowered pressure. At operating pressure working on the tightening screw (11) may lead to unintended response of the safety valve. When discharging, some leaking medium may escape at the spindle guide of the tightening screw (11). Danger of scalding by hot steam!

Remove lead seal. Unscrew cap (13). Loosen lock nut (28). For working at the tightening screw (11) secure spindle (7) e. g. with a pin against rotation as otherwise the valve seat may be damaged.

Tighten tightening screw (11) (turn right): set pressure higher
loosen tightening screw (11) (turn left): set pressure lower

After the adjustment secure tightening screw (11) with lock nut (28). Mount cap (13) and lead seal.

Standard values for the change of the set pressure in % for a quarter turn of the tightening screw (11):

orifice letter SKB	AIV EAIV	AI-III, B, C EAI-III, FA	D-H GA-KA	J-M LA-NA	N-R PA-RA	S-W TA	X-Z
changes in %	10	7	4	3	1,5	1	0,5

Precision of the set pressure adjustment: ± 3 %

3.9 Functional Differences

	VSE 1 Standard	VSE 1, with compensating piston SN 144	VSR 1 (with adjusting ring) Standard	VSR 1, with compensating piston SN 144
opening pressure difference	+ 5 %	+ 3 %	+ 3 %	+ 3 %
closing pressure difference	– 10 %	– 10 %	– 8 %	– 6 %

	VSE 2 Standard	VSE 2, with valve seat for liquids SN 123	VSR 2 (with adjusting ring) Standard	VSR 2, with valve seat for liquids SN 123
opening pressure difference	+ 5 %	+ 10 %	+ 3 %	+ 10 %
closing pressure difference	– 10 %	– 20 %	– 8 %	– 10 %

For set pressures below 3 bar the closing pressure difference may be up to 0.3 bar.

Changing the Closing Pressure Difference for VSR 1 and VSR 2

After removing the lock screw (44), the closing pressure difference can be changed by means of the adjusting ring (14). The sum of opening and closing pressure difference remains approximately the same.

Attention! Remove lock screw (44) only with lowered pressure. At operating pressure adjusting the adjusting ring (14) may lead to unintended response of the safety valve. When discharging the safety valve or in case of untight valve seat, medium may escape out of the opened adjusting bore. Danger of scalding by hot media, e. g. steam!

For adjusting, put screwdriver through the opening and adjust adjusting ring (14) groove by groove. Its graduation equals about 0.2 mm of vertical adjustment.

Screw adjusting ring (14) up = closing pressure difference lowers. Turn in and tighten lock screw (44) again.

3.10 Trouble Shooting

Malfunction	Cause	Remedies
Safety valve opens at different pressures.	Condensate in the inlet line.	Improve insulation of line. Observe drain and slope.
	Pressure change by superimposed vibration.	Suppress vibrations at the safety valve.
Safety valve opens and closes in rapid succession.	Pressure loss in the inlet line is greater than the closing pressure difference.	For VSR enlarge closing pressure difference. Otherwise reduce flow resistance of the inlet line: Expand, shorten or remove constrictions. Fast remedy: Decrease lift (as far as allowed), therefore diminish outflow.
	Discharge quantity is too small because the subsequent flow is too small.	Install smaller safety valve or adjust discharge quantity.
	Admissible back pressure is exceeded in the exhaust line.	Decrease flow resistance of the exhaust line: e.g. by expanding or shortening the line.
	Dynamic pressure drop in the inlet line, especially in case of liquids.	Provide safety valve with a vibration damper.
Closing pressure difference is too great.	Saturated steam with high moisture. Adjusting ring (14) of VSR is not adjusted correctly.	For VSR change closing pressure difference.
Safety valve stays open after discharge test.	Foreign bodies between seat zone (3) and disc (4).	Repeat discharge test or blow off foreign bodies by lifting the lever (36). Otherwise disassemble valve.
Safety valve fails to close tightly.	Valve seat damaged.	Disassemble valve. Rework valve seat and disc (4).
	Difference between operating and set pressure is too small.	Enlarge difference or mount supplementary loading.
	Body forming by line forces.	Lay line elastically.
	No slope of the inlet line in case of hot liquids.	Assemble inlet line with slope to the safety valve or lay siphon-type bend.

4 Inspection and Maintenance Works

Determine inspection intervals depending on frequency of response and operating conditions. Keep certificates about performed works at the safety valve.

Before commissioning again drain safety valve.

While controlling

- Check valve for tightness. In doing so, take care of the following indications: whistling noises, medium at the bonnet, medium at the drain nozzle or in the exhaust line.

Inspection

- Check each sealing. Replace if leaky.
- Check seat faces.
- Smooth valve seat and disc (4) with fine lapping paste. If necessary, replace disc (4).
- Equalise guide areas of the spindle (7); when doing so, do not apply material removing machine works.

At larger intervals, e.g. each 3 years

- Completely disassemble safety valve.
- Clean and check valve parts.
- Smooth valve seat and disc (4) with fine lapping paste. If necessary, replace disc (4). In case of rework observe functionally important outlines at the valve seat.
- Replace spring (10) when damaged by corrosion or temperature and readjust set pressure.
- Equalise guide areas of the spindle (7); when doing so, do not apply material removing machine works.
- Lubricate roller bearing (48) and tightening screw (11).
- Treat ball (18), sliding guides not in contact with the medium, fits, gaskets and threads with an assembling lubricant.

Attention! Do not treat valve seats, metallic sealing surfaces and sliding guides in contact with the medium.

Attention! For oxygen application all parts in contact with the medium must be free from oil and grease. Danger of explosion!

5 Disassembly

5.1 Danger and Warning Indications

Take work order and wait until the installation is switched free.

Check if the valve is pressureless and cooled down.

Residual medium may escape when opening and disassembling the valve; also at pressureless plant further evaporations are possible.

Before disassembly switch off electrical supply, loosen plug or disconnect cable.

Loosen nuts (9.1) only when the spring (10) is released as the studs (9) cannot absorb the initial stress in the spring (10).

5.2 Instructions for Disassembly

- First dismount supplementary loading. Disassemble position indicator only if necessary.
- For works at lifting nuts (12) or tightening screw (11) secure the spindle (7) e. g. with a pin against torsion as otherwise the valve seat can be damaged.

5.3 Tools

- fixed spanner 10 - 80 mm
- socket wrench 17 mm
- screwdriver 8 mm
- retaining ring pliers for outer rings
- flatnose pliers
- side cutting pliers
- hammer
- punch Ø 2,5; 3; 4 mm
- seal wire
- lead seal
- lead-sealing pliers
- vernier calliper
- lapping wheel
- washer for M10, M16, M24

In case of very great safety valves (SKB X, Y and Z) it is possible that there are other parts or parts arrangements than described in this operating instruction because of special design conditions. Please observe special, order specific assembly drawing.

5.4 Utilities

- Lapping abrasive: Tetraboric carbide 180 - 1200, Wasels, Altena
- Lapping abrasive for disc out of material 1.4980: Diamond suspension 2 - 30 µm. Mikrodiamant GmbH, Ostfildern
- Degreasant: Kaltron 113MDS/113MDK/113MDI35. Frigen 113TR-T. Freon PCA/TF/T-P35/TA. Isopropyl alcohol with acetone, mixture 1 : 1.
- Lubricant for assembly (MoS_2): Molykote-Spray, Dow Corning, Munich.
- Lubricant for assembly (Colloidal-Graphite) for parts in contact with the medium: DAG156 Acheson, Ulm. Neolube 1, 2, Van Meeuven, NL-1380 AA Weesp.
- Only to facilitate assembling: Lubricating grease for bearings, spindle thread, screws and the like: Molykote-BR2plus (≤ 80 °C); BG20 (> 80 °C), Dow Corning, Munich; Barrierta L55/2 (> 120 °C), Klüber, Munich, Mobilgrease Spec., Mobil Oil
- O-ring grease: DOW Corning, Munich

Attention: For oxygen application all parts in contact with the medium must be free from oil and grease. Danger of explosion.

5.5 Dismantling the Safety Valve

.

Remove lead seal. Dismount cap (13). Remove split pin (29) and lifting nuts (12) or loosen and remove checked lifting nuts (12). Measure and record distance between upper edge of spindle (7) and tightening screw (11). Loosen lock nut (28) and release spring (10) by means of tightening screw (11).

Loosen nuts (9.1) and lift off bonnet (8). Remove spring (10), cooling spacer (15) (if installed), gasket (26), spindle (7) and guide bush (6). In case of VSR 1 and VSR 2 do not change position of the adjusting ring (14); mark, if necessary. Remove disc (4) and ball (18); at orifice letter SKB: D - W drive out dowel pin (19). The guide piston (5) will not be disassembled. Dismount cap (13) with lever (36) only if necessary.

6 Assembly

For SKB D - W: fasten disc (4) and ball (18) by means of dowel pin (19) to the spindle (7).

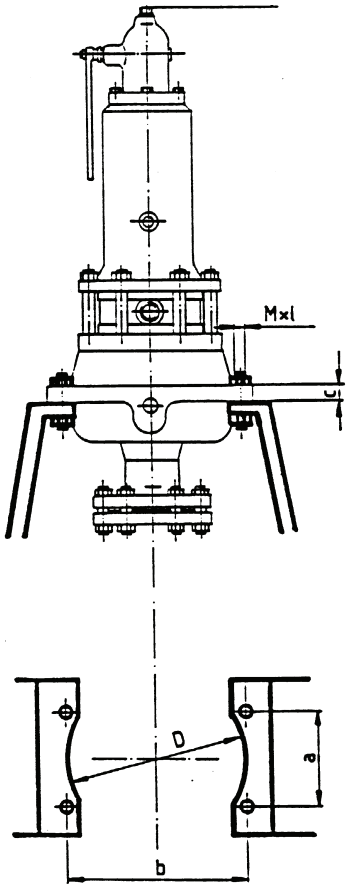
Insert guide bush (6); for VSR 1 and VSR 2 observe marked position of the adjusting ring (14). Insert disc (4), ball (18) and spindle (7). Put over cover (16) possibly with slide ring (43). According to design put on cooling spacer (15), split ring (20), stop bush (21), distance bush (22), pressure bush (23), spring stop (24), spring (10), spring plate (25) and roller bearing (48).

Put on bonnet (8) and screw tight with hexagonal nuts (9.1). Prestress spring (10) by means of tightening screw (11) onto the same dimension as measured before disassembling; thus the same set pressure as before. Secure tightening screw (11) with lock nut (28). Screw on two lifting nuts (12) at the upper end of the spindle (7) and secure them or screw on lifting nuts (12) and tighten with split pin (29).

Mount cap (13) and lead seal. Check easy motion and function of the lever (36) with fork (31). If available, mount supplementary loading.

7 Dimensions for Mounting Bracket

orifice letter SKB			dimensions in mm				
Sempell	API		a	b	c	D	
A	EA	III - IV	106	152	10	160	M12 x 65
B	FA	III	106	152	10	160	M12 x 65
		IV	104	194	10	180	M12 x 65
C		III	106	152	10	160	M12 x 65
		IV	104	194	10	180	M12 x 65
D	GA	I	98	140	10	150	M 8 x 55
		II	106	152	10	160	M12 x 65
		III - IV	104	194	10	180	M12 x 65
E	HA	I	98	140	10	150	M 8 x 65
		II	106	152	10	160	M12 x 65
		III - IV	104	194	10	180	M12 x 65
F		I	126	180	12	190	M12 x 65
		I - IV	138	196	15	200	M16 x 80
G	JA	I - II	138	196	15	210	M16 x 80
		III - IV	138	196	15	210	M16 x 80
H	KA	I - II	160	230	15	250	M16 x 80
		III - IV	160	230	15	250	M16 x 80
J		I - III	184	262	15	290	M16 x 80
		IV	184	262	15	290	M16 x 80
K	LA	I - IV	192	274	15	300	M16 x 80
L	MA, NA	I - IV	200	286	15	310	M16 x 80
M		I - IV	230	328	15	370	M16 x 80
N	PA	I -III	242	344	20	380	M20 x 100
P		I -III	288	410	20	460	M20 x 100
Q	QA	I -III	288	410	20	460	M20 x 100
R	RA	I -III	288	426	20	480	M20 x 100
S	TA	I	350	350	25	430	M20 × 135
T		I	400	400	30	480	M20 × 135
U		I	450	450	30	530	M20 × 140
V		I	550	550	30	680	M20 × 140
W		I	640	640	30	780	M20 × 140
X		I	720	720	60	900	M24 × 180
Y		I	860	860	60	1050	M24 × 180
Z		I	950	950	60	1140	M24 × 180



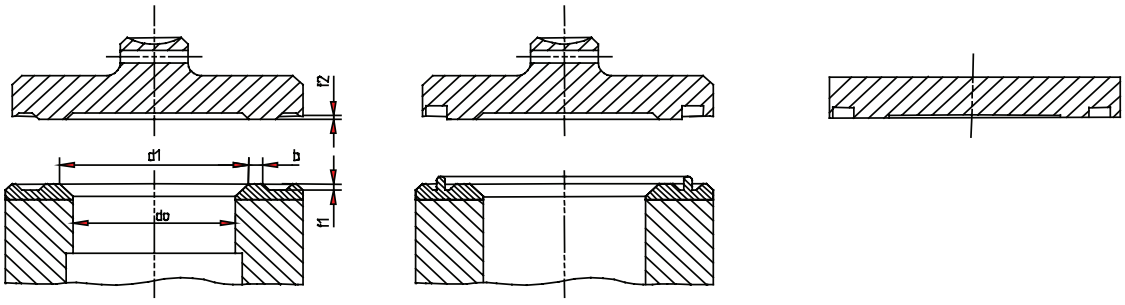
8 Functionally Important Outlines at the Valve Seat

orifice letter SKB		group	functionally important outlines in mm						
Sempell	API		do H8	d1 - 0,1	b min.	b max.	f1 - 0,3	f2 ① - 0,1	f2 ② - 0,1
A	-	IV	13,0	14,4	1,05	1,20	0,5	0,4	1,1
A	EA	I - III	18,0	19,9	1,30	1,45	0,5	0,4	1,1
B-C	FA	I - IV	18,0	19,9	1,30	1,45	0,5	0,4	1,1
D-E	GA-HA	I - IV	24,5	27,1	1,20	1,35	1,0	0,6	1,1
F	-	I - IV	28,0	30,9	1,30	1,45	1,0	0,6	1,1
G	JA	I - IV	33,0	36,4	1,30	1,45	1,0	0,8	1,6
H	KA	I - IV	38,0	41,9	1,55	1,70	1,0	0,8	1,6
J	-	I - IV	44,0	48,5	1,25	1,45	1,0	1,0	1,6
K	LA	I - IV	51,0	56,2	1,40	1,60	1,0	1,0	1,6
L	MA-NA	I - IV	59,0	65,0	1,50	1,70	1,0	1,3	2,1
M	-	I - IV	69,0	76,0	1,50	1,70	1,0	1,3	2,1
N	PA	I - III	80,0	88,1	1,45	1,75	1,5	1,6	2,1
P	QA	I - III	93,0	102,4	1,30	1,60	1,5	1,6	2,1
Q	-	I - III	107,0	117,7	1,35	1,65	1,5	1,9	2,6
R	RA	I - III	126,0	138,6	1,40	1,70	1,5	1,9	2,6
S - Z	TA	I	from orifice letter S on request						

Valve seat for vapours, steam

Valve seat for liquid

lapping wheel with gases, groove for liquid



① for gases, vapours and liquids
② for steam

9 Methods to Produce Superfinished Sealing Surfaces

Attention! Lapping is a precision operation and must be carried out by trained personnel. Various operating areas ask for various operating methods.

9.1 Lapping Area Production

9.1.1 Disc

Parts with flat seats are normally machine lapped.

Procedure:
Allow boron carbide lapping emulsion (a mixture of grade 800 lapping powder and lapping oil) to drip onto the constantly rotating lapping machine wheel. Load the items to be lapped into a suitable locator that is set eccentrically to the table.

The lapping operation takes 15 to 20 minutes depending on the quality of the prepared sealing surface. Afterwards the parts will be polished. In case of parts made of material 1.4980 the parts will additionally polished on a tin plate with a diamond suspension; grain size 2 - 3. A sight control and a test with an interference glass follow to check whether the surface is plane and not convex or concave.

9.1.2 Valve Seat

The preferred method is hand operated machine lapping in case the valve seat is installed in the body (screwed in, welded in or in another connection). Thereby it is important that the required force is constantly and steadily transferred through a spring.

Procedure:
Grinding and/or lapping foils of different grain sizes are pasted onto a plain carrier wheel of the machine. The prepared seating areas with 3.2 Ra roughness are alternately lapped with grain sizes of 200-600-1000. After lapping with 200 grain size, there should be no visible tool marks. The change takes place at intervals of about 1 minute. Lapping is carried out with oscillating movements. Finally the seating area is cleaned and visually inspected.

9.2 Lapping Area Site

As a rule, there is no lapping machine available so only a manual method or the method described in section 9.1.2 can be used.

9.2.1 Disc

Depending upon their size, lap the parts on glass plates or discs or rings made of grey cast iron. Lapping abrasive: Tetra Bor lapping paste (grade 120 to 1200).
Procedure:
Up to a size of about 200 mm diameters lap the parts on the plates. In case of greater diameters, use the part to be lapped as a pad and move the discs or rings. Thinly distribute the lapping abrasive on one side and up a grain size > 400 additionally sprinkle it with oil drops. Oscillatingly move the valve part or the lapping wheel with constant hand pressure. This operation takes several minutes. Remove the paste with a cold cleaning and repeat the procedure using progressively finer lapping paste. Finally a sight control follows.

Up to a size of approx. 200 mm diameter lap the discs with a mobile manual lapping machine according to section 9.1.2.

9.2.2 Valve Seat

Procedure see section 9.1.2.

Attention! Check body seats regularly to verify that the seat surfaces are still rectangular to the body centre. If this is not the case, restore squareness by using a flat grinding machine.

10 Declaration

Conformity Declaration

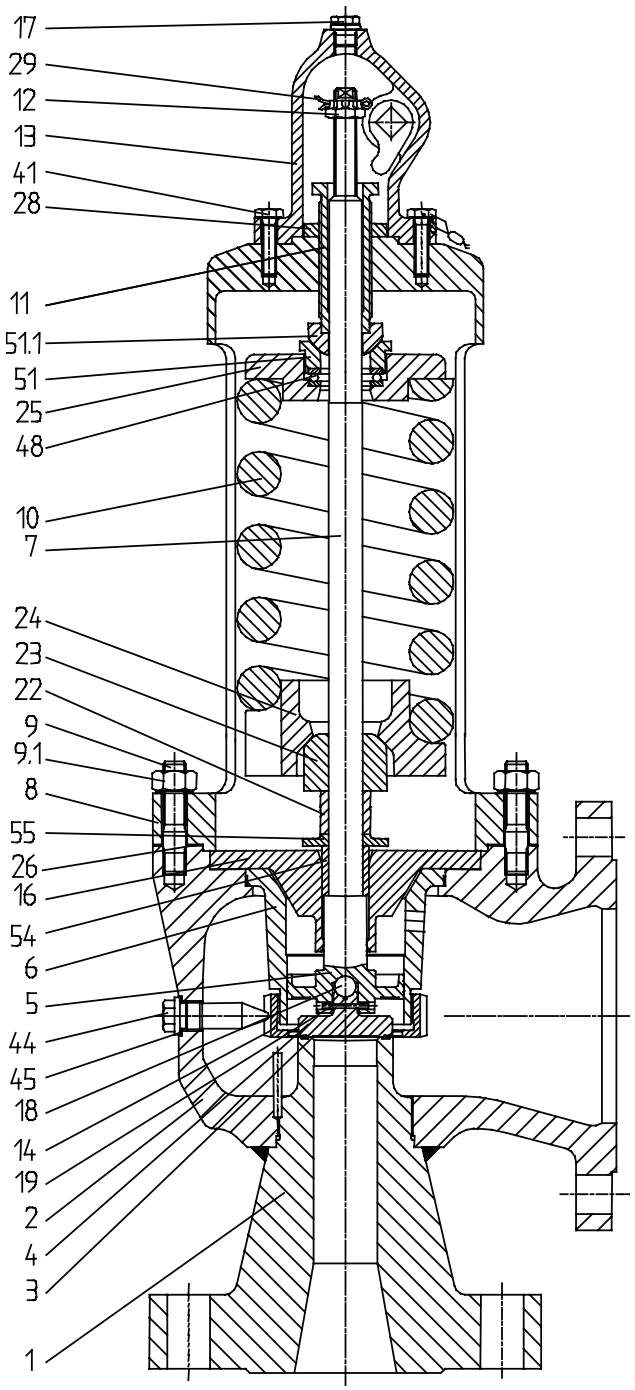
1	Manufacturer	Forbes Marshall A 34/35 MIDC Industrial Estate Pimpri Pune
2	Pressure Device	**Safety Valves VSE, VSR**
3	Designated Agency	TÜV-CERT-Certification agency for QM-Systems of TÜV Rheinland Anlagentechnik GmbH Am Grauen Stein, 51101 Köln registration number **0035**
4	Applied documents	type test **VdTÜV SV 519, 551**
5	Designated Agency Supervising Quality Assurance	TÜV-CERT-Certification agency for QM-Systeme of TÜV Rheinland Anlagentechnik GmbH Am Grauen Stein, 51101 Köln
6	Applied Standards and Specification	TRD 421, AD-MerkblattA2, TRD 110, VdTÜV-Merkblatt SV 100, AD 2000

11 Part List and Assembly Drawings VSE 1 and VSR 1

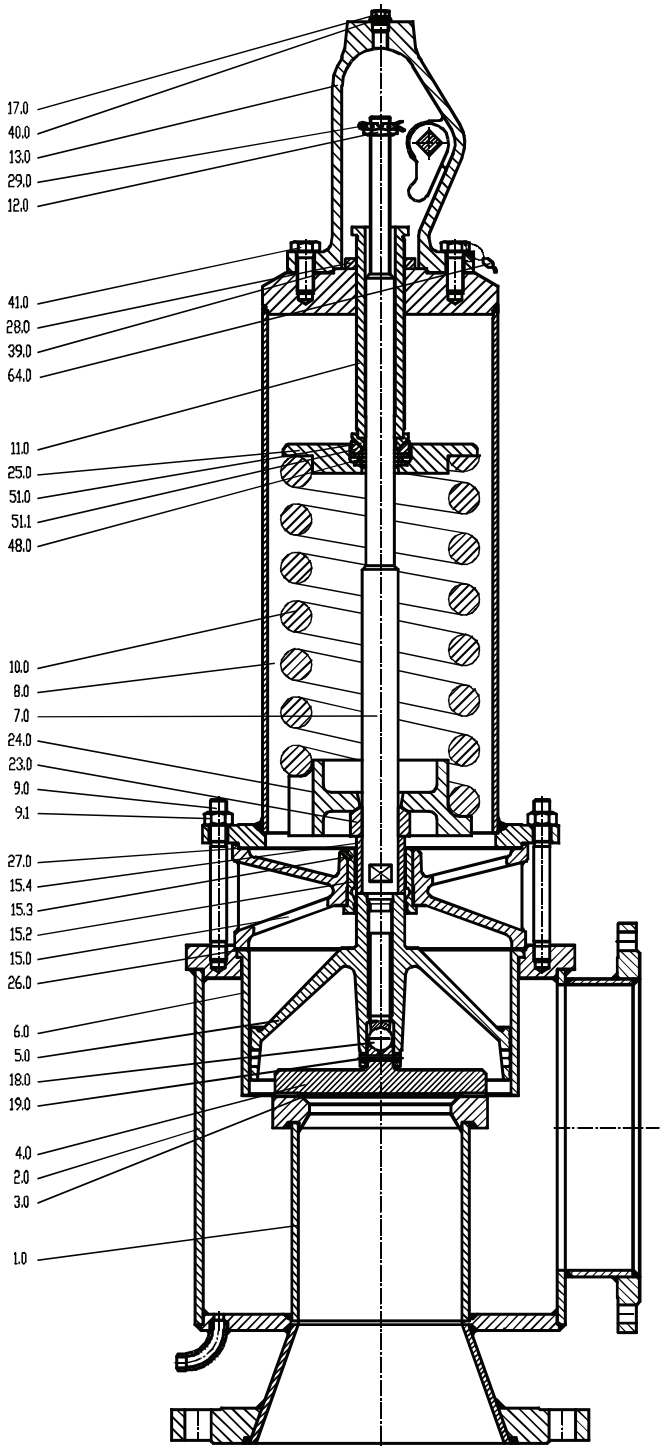
VSR 1, SKB J - R, with adjusting ring

Part	Name
1	inlet nozzle
2	body
3	seat zone
● 4	disc
5	guide piston
6	guide bush
7	spindle
8	bonnet
9	stud
9.1	nut
10	spring
11	tightening screw
12	lifting nut
13	cap
14	adjusting ring
15	cooling spacer
16	cover
17	gag plug
● 18	ball
● 19	dowel pin
22	distance bush
23	pressure bush
24	spring stop
25	spring plate
● 26	gasket
28	nut
29	split pin
30	bush
31	fork
32	square shaft
36	lever
37	washer
38	hexagon nut
41	cap screw
43	slide ring (for SN 144)
44	lock screw
45	gasket
47	circlip
48	roller bearing
51	pressure plate
51.1	bearing bush
54	guard ring
55	baffle plate

● recommended spare parts



VSE 1, SKB S - Z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40.0
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29.0
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28.0
39.0
64.0
11.0
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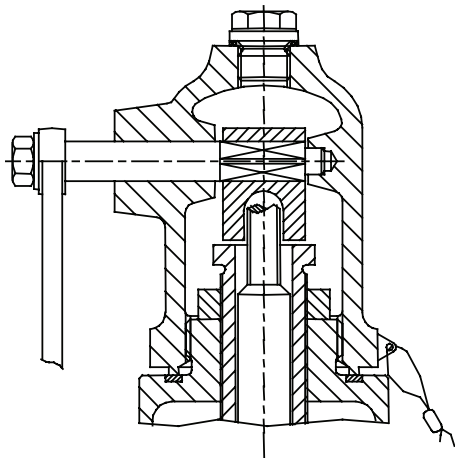
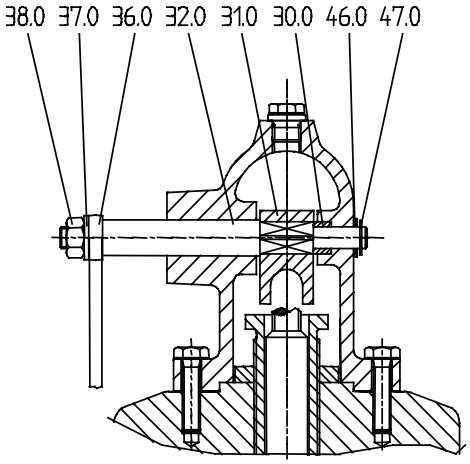
48.0
10.0
8.0
7.0
24.0
23.0
9.0
9.1
27.0
15.4
15.3
15.2
15.0
26.0
6.0
5.0
18.0
19.0
4.0
2.0
3.0
1.0

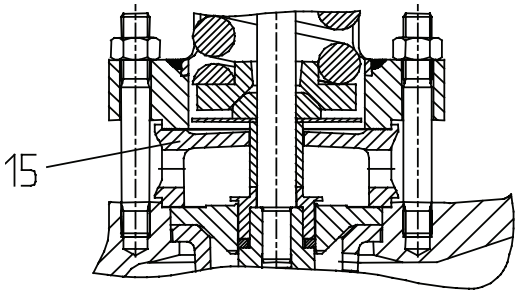
Screwed cap
SKB A - H



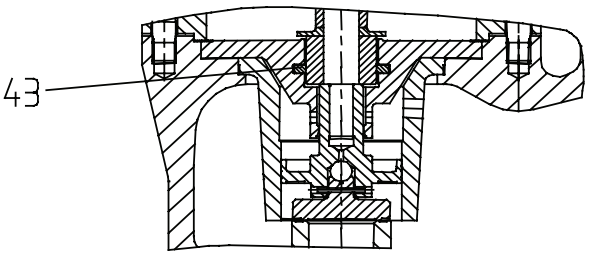
Flanged cap
SKB J – Z



Accessory 110 cooling spacer
as spring protection at operating temperatures over 400 °C



Accessory 144 compensating piston

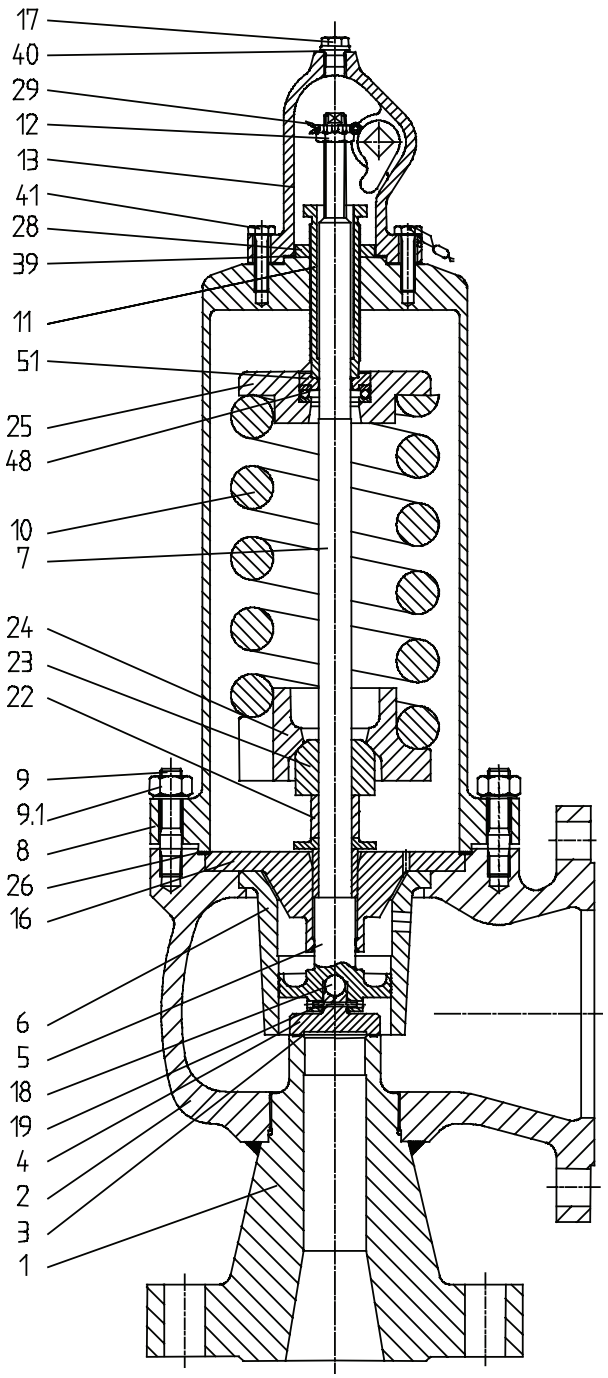


12 Part List and Assembly Drawings VSE 2 and VSR 2

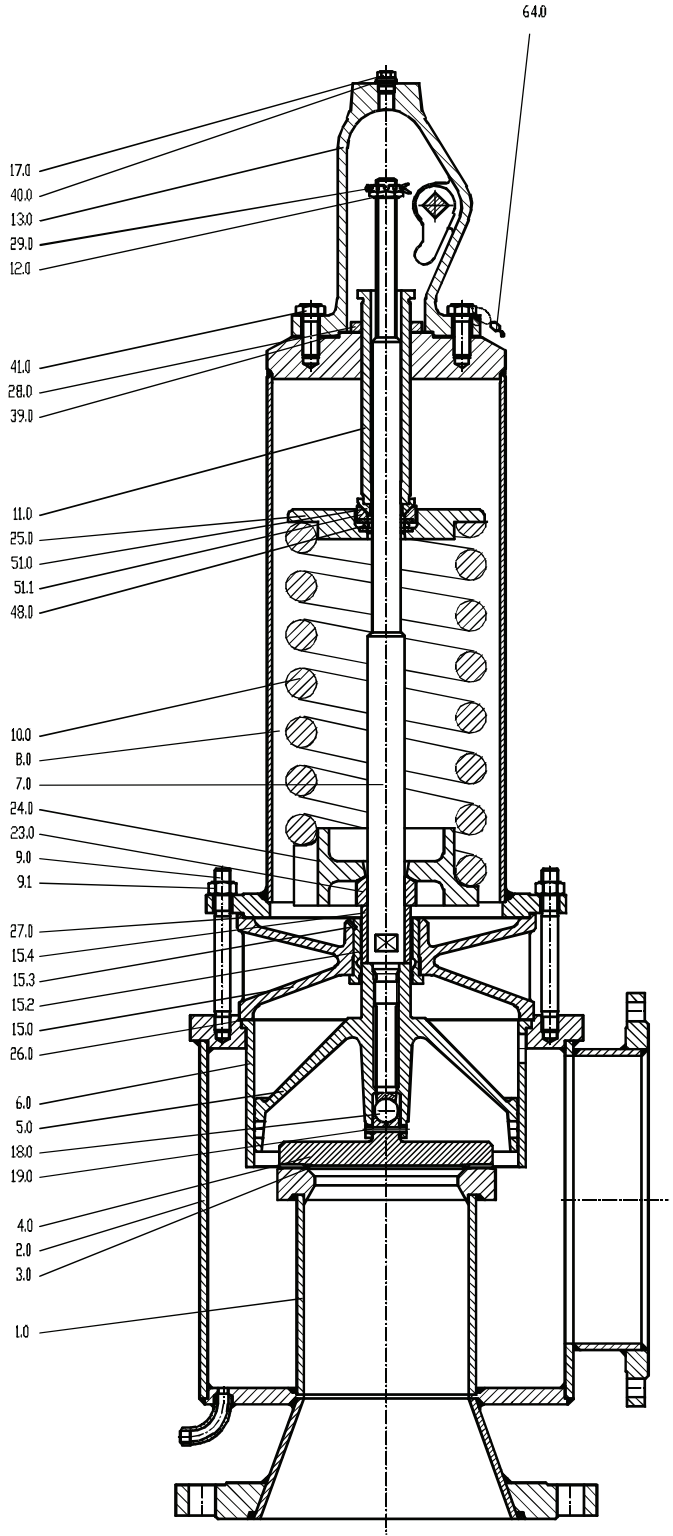
VSE 2, SKB J - R

Part	Name
1	inlet nozzle
2	body
3	seat zone
● 4	disc
5	guide piston
6	guide bush
7	spindle
7.1	screw bolt
8	bonnet
9	stud
9.1	nut
10	spring
11	tightening screw
12	lifting nut
13	cap
14	adjusting ring
15	cooling spacer
16	cover
17	gag plug
● 18	ball
● 19	dowel pin
22	distance bush
23	pressure bush
24	spring stop
25	spring plate
● 26	gasket
28	lock nut
29	split ring
30	bush
31	fork
32	square shaft
33	bottom ring
34	packing
35	gland
36	lever
37	washer
38	hexagon nut
39	gasket
40	gasket
41	cap screw
44	lock screw
45	gasket
48	roller bearing

● recommended spare parts



VSE 2, SKB S – Z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13.0
29.0
12.0
41.0
28.0
39.0
11.0
25.0
51.0
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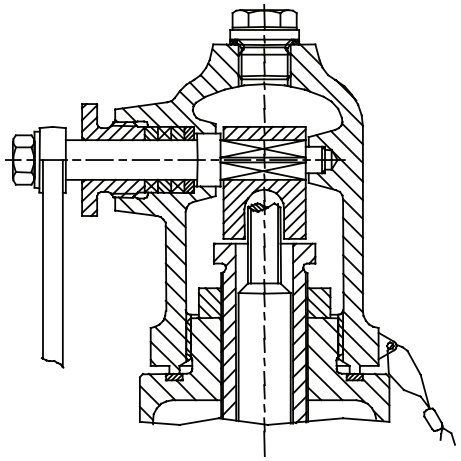
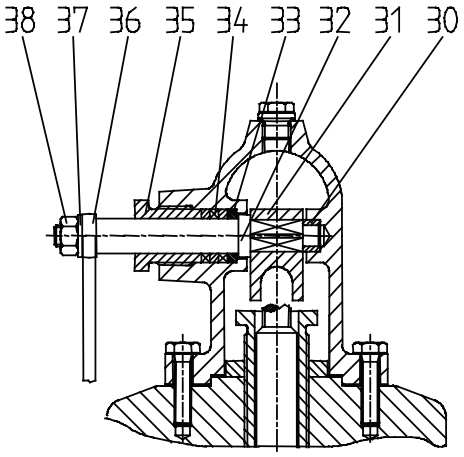
48.0
10.0
8.0
7.0
24.0
23.0
9.0
9.1
27.0
15.4
15.3
15.2
15.0
26.0
6.0
5.0
18.0
19.0
4.0
2.0
3.0
1.0

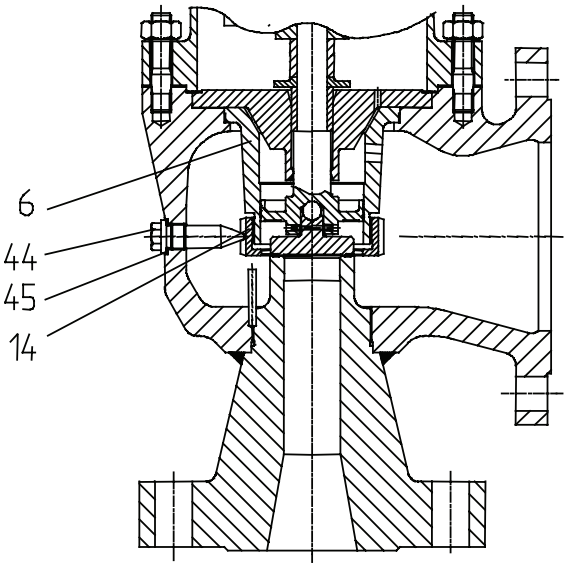
Screwed cap
SKB A - H



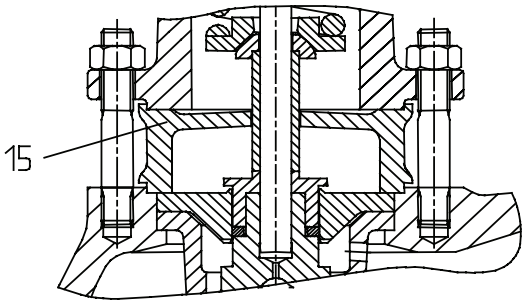
Flanged cap
SKB J – Z



VSR 2 with adjusting ring (to SKB S)

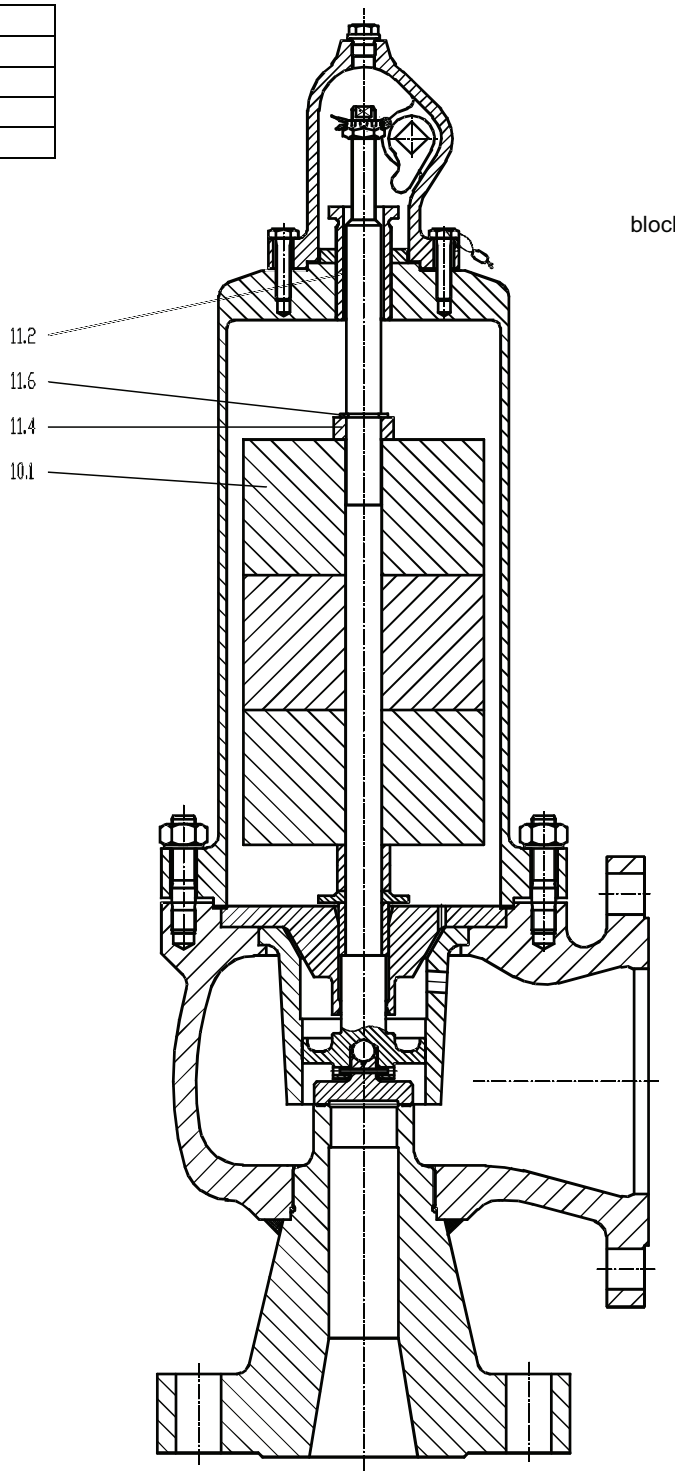


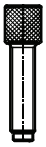
Accessory 110 cooling spacer
as spring protection at operating temperatures between 400 °C and - 90 °C



13 Part List and Assembly Drawing VSE 4

Part	Name
10.1	Weight
11.2	Guide screw
11.4	Distance pipe
11.6	Retaining ring





blocking screw for transport

CD Pouch to be pasted here.

Your local Forbes Marshall representative would be happy to provide you with further information and support.

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